JOURNAL

OF THE

ARNOLD ARBORETUM

VOLUME XV. OCTOBER, 1934 NUMBER 4

NOTES ON THE LIGNEOUS PLANTS DESCRIBED BY LEVEILLE FROM EASTERN ASIA[1]

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CLETHRACEAE

Clethra Bodinieri Léveillé in Fedde, Rep. Spec. Nov. x. 475 (1912); Fl. Kouy-Tchéou, 147 (1914).

CHINA. K w e i c h o u : Pin-fa, près ruisseaux, montagnes, *J. Cavalerie,* no. 510, Sept. 24, 1902 (holotype; photo. in A. A.)

This species seems closely related to *C. Fabri* Hance from which it is easily distinguished by the rather narrow remotely denticulate leaves with only 5-10 small mucro-like teeth on each side and by the very slender pedicels 6-7 mm. long. The specimen is in young fruit. Handel-Mazzetti according to a note on the type sheet refers to this species also Ching no. 5734 and 5804 which I have not seen.

Clethra Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. x. 476 (1912); Fl. Kouy-Tchéou, 147 (1914).

Clethra Esquirolii Léveillé, l. c. 475 (1912); l. c. 147 (1914).

Clethra lineata Léveillé in Fedde, Rep. Spec. Nov. XII. 534 (1913); Fl. Kouy-Tchéou 148 (1914).

CHINA. K w e i c h o u : Pin-fa, *J. Cavalerie,* no. 5 (not 35), July 10, 1902, "haut 1 - 2 mètres, fl. blanches, legèrement odorantes" (holotype of *C. Cavaleriei;* photo. in A. A.); environs de Tou-chan, *J. Cavalerie,* July 19, 1898 (syntype of *C. Esquirolii;* merotype and photo. in

[1]Continued from p. 117; for preceding parts see Vol. x. 108-132, 164-196; XII. 275-281; XIII. 229-332; XIV. 223-252; XV. 1-27.

A. A.); Hoa-ouan-jao, *J. Esquirol,* no. 651, Aug. 1905, "fl. blanche" (syntype of *C. Esquirolii;* photo. in A. A.); moulins de Tong-tchéou, *J. Esquirol,* no. 3238, July 10, 1912 (holotype of *C. lineata;* photo. in A. A.).

The specimens enumerated above are apparently all conspecific and closely related to *C. Fargesii* Franch. from which they are readily distinguished by the usually solitary raceme or occasionally with one or two additional smaller ones, and by the larger flowers with oblong-lanceolate sepals and glabrous filaments. From *C. Delavayi* Franch. and *C. monostachya* Rehd. & Wilson they differ in the glabrous style and in the petals being sparingly pilose inside.

I have adopted the name *C. Cavaleriei* for the following reasons though in the original article *C. Esquirolii* appears on the preceding page: (1) the name has been already used by Dr. Handel-Mazzetti who has distributed specimens under this name, (2) the type of *C. Cavaleriei* is a specimen in good flowering condition. Esquirol's no. 651 which must be considered, on account of the name, the type of *C. Esquirolii,* is in a rather poor condition.

Clethra Cavaleriei has been collected in Kweichou also by Handel-Mazzetti (no. 10557) and by Steward, Chiao & Cheo (no. 394).

Clethra kaipoensis Léveillé in Fedde, Rep. Spec. Nov. x. 475 (1912); Fl. Kouy-Tchéou, 147 (1914).

Clethra pinfaensis Léveillé, l. c. 476 (1912); l. c. 148 (1914).

China. Kweichou: Tsin-gay (Kai-po), montagnes, *J. Cavalerie,* no. 1221, August 5, 1903 "haut 1 à 2 m., fl. blanches" (holotype of *C. kaipoensis;* photo. in A. A.); Pin-fa, *J. Cavalerie,* no. 346, Aug. 31, 1902 (holotype of *C. pinfaensis;* photo. in A. A.).

This species is apparently closely related to *C. Fargesii* Franch. but is easily distinguished by the rather shaggy and fulvous pubescence of the inflorescence, not close and whitish gray, by the short pedicels 1-3 mm. long and the short ovate-lanceolate bracts which even in the very young inflorescence do not exceed the flower-buds.

Clethra kaipoensis has been collected in Kweichou also by Handel-Mazzetti (nos. 10766 and 10997) who has distributed these numbers as *C. pinfaensis,* but as Cavalerie no. 1221 is a much better specimen and precedes *C. pinfaensis* in Léveillé's enumeration I have adopted *C. kaipoensis* as the name for this species.

RHODODENDRON L.[1]

Subgen. I. **EURHODODENDRON** Endl.

Sect. 1. LEIORHODION Rehd.

Arboreum Series: Argyrophyllum Subseries

Rhododendron denudatum Léveillé in Fedde, Rep. Spec. Nov. XIII. 339 (1914); Cat. Pl. Yun-Nan, 89 (1916). — Tagg in Rhodod. Soc. Notes, III. 228, 231 (1928); in Spec. Rhodod. 24 (1930).

Rhododendron xanthoneuron Léveillé in Fedde, Rep. Spec. Nov. XIII. 340 (1914); Cat. Pl. Yun-Nan, 94 (1916).

China. Yunnan: rochers de Tien-sin, 3000 m., *E. E. Maire,* April 1913 (holotype of *Rh. denudatum*); mont Te-pe-lou, 3200 m., *E. E. Maire,* May 1913 (holotype of *Rh. xanthoneuron*).

Rhododendron denudatum is closely related to *Rh. floribundum* Franch. It is probably a valid species.

Rhododendron farinosum Léveillé in Fedde, Rep. Spec. Nov. XIII. 340 (1914); Cat. Pl. Yun-Nan, 90 (1916). — Tagg in Rhodod. Soc. Notes, III. 229 (1928); in Spec. Rhodod. 25 (1930).

China. Yunnan: flanc du Io-chan, 3200 m., *E. E. Maire,* May 1913 (holotype).

This is almost certainly a valid species and closely related to *Rh. floribundum* Franch. and *Rh. denudatum* Lévl.

Taliense Series: Adenogynum Subseries

Rhododendron cruentum Léveillé in Fedde, Rep. Spec. Nov. XII. 284 (1913); Cat. Pl. Yun-Nan, 89 (1916). — Tagg in Rhodod. Soc. Notes, III. 228 (1928); in Spec. Rhodod. 640 (1930).

China. Yunnan: brousse du plateau de Ta-hai-tse, 3200 m., *E. E. Maire,* May 1912 (holotype).

This is closely related to *Rh. Bureavi* Franch.

Lacteum Series

Rhododendron lacteum Franchet in Bull. Soc. Bot. France, XXXIII. 231 (1886). — Tagg in Rhodod. Soc. Notes, III. 230 (1928); in Spec. Rhodod. 381 (1930).

Rhododendron Mairei Léveillé in Fedde, Rep. Spec. Nov. XII. 285 (1913); Cat. Pl. Yun-Nan, 92 (1916).

China. Yunnan: montagnes de Lai-teou-po, 3000 m., *E. E. Maire,* May 1912 (holotype of *Rh. Mairei*).

[1]The following determinations and comments (except those of the subgenus Anthodendron) on Léveillé's specimens were kindly sent me by Sir William Wright Smith, Regius Keeper of the Royal Botanic Garden of Edinburgh, who with Mr. H. F. Tagg has for years made a special study of Chinese rhododendrons.

THOMSONI Series: SOULIEI Subseries

Rhododendron Souliei Franchet in Jour. de Bot. IX. 393 (1895). — Tagg in Rhodod. Soc. Notes, III. 228 (1928); in Spec. Rhodod. 732 (1930).

Rhododendron cordatum Léveillé in Bull. Géog. Bot. XXIV. 282 (1914); Cat. Pl. Yun-Nan, 89, fig. 21 (1916).

CHINA. Yunnan: sommet du Io-chan, 3400 m., *E. E. Maire,* June 1913 (holotype of *Rh. cordatum*).

The material of *Rh. cordatum* is very fragmentary, but there is little doubt that it is *Rh. Souliei* Franch.

FORTUNEI Series: FORTUNEI Subseries

Rhododendron decorum Franchet in Bull. Soc. Bot. France, XXXIII. 230 (1886). — Tagg in Rhodod. Soc. Notes, III. 227, 229 (1928); in Spec. Rhodod. 269 (1930).

Rhododendron Franchetianum Léveillé in Bull. Soc. Agric. Sci. Arts Sarthe, XXXIX. 46 (1903); Cat. Pl. Yun-Nan, 91 (1916).

?*Rhododendron albicaule* Léveillé in Fedde, Rep. Spec. Nov. XIII. 148 (1914). — Tagg in Spec. Rhodod. 851 (1930).

Rhododendron Giraudiasii Léveillé in Fedde, Rep. Spec. Nov. XIII. 340 (1914).

CHINA. Kweichou: montagnes de Sin-tchen, près Hin-y-hien, *J. Cavalerie,* no. 3923, June 1912 (holotype of *Rh. albicaule*). Yunnan: rochers, mont de Siao-ou-long, 2700 m., *E. E. Maire,* June 1917 (holotype of *Rh. Giraudiasii*); environs de Yunnan-sen, sur les hautes montagnes bordant la plaine, *E. Bodinier,* Nov. 11, 1896, *F. Ducloux,* March 28, 1897 "fort arbuste de 2 m.; floraison précoce; fleurs blanches avec quelque pointillé à la partie supérieure" (syntypes of *Rh. Franchetianum*).

The material of *Rh. albicaule* in the Herbarium Léveillé is *Rh. decorum,* but Léveillé's description does not fit the specimen well. In Flore du Kouy-Tchéou, p. 152, Léveillé cites *Rh. albicaule* as a synonym of *Rh. Cavaleriei,* a species of the Stamineum Series. This is obviously an error, as the specimen under Cavalerie 3923 is *Rh. decorum.* Moreover, Léveillé's description does not fit in with a member of the Stamineum series.

FALCONERI Series

Rhododendron rex Léveillé in Fedde, Rep. Spec. Nov. XIII. 340 (1914); Cat. Pl. Yun-Nan, 93 (1910). — Tagg in Rhodod. Soc. Notes, III. 230 (1928); in Spec. Rhodod. 250 (1930).

CHINA. Yunnan: mont Io-chan, 3200 m., *E. E. Maire,* May 1913 (holotype).

Sect. 2. LEPIPHERUM G. Don

Maddenii Series: Megacalyx Subseries

Rhododendron liliiflorum Léveillé in Fedde, Rep. Spec. Nov. xii. 102 (1913); Fl. Kouy-Tchéou, 153 (1914). — Hutchinson in Notes Bot. Gard. Edinb. xii. 33, fig. 5 (1919); in Spec. Rhodod. 493 (1930). — Tagg in Rhodod. Soc. Notes, iii. 229 (1928).

China. Kweichou: Pin-fa, Juin-ou-chan, *J. Cavalerie*, no. 54, June 3 and July 15, 1902 (syntypes).

Maddenii Series: Ciliicalyx Subseries

Rhododendron Lyi Léveillé in Fedde, Rep. Spec. Nov. xiii. 147 (1914); Fl. Kouy-Tchéou, 153 (1914). — Hutchinson in Notes Bot. Gard. Edinb. xii. 33 (1919); in Spec. Rhodod. 467 (1930). — Tagg in Rhodod. Soc. Notes, iii. 230 (1928).

China. Kweichou: Gan-chouen, *J. Cavalerie*, no. 3883, April 1912 (holotype).

Rhododendron missioniarium Léveillé in Bull. Géog. Bot. xxv. 20 (1915); Cat. Pl. Yun-Nan, 92 (1916). — Hutchinson in Not. Bot. Gard. Edinb. xii. 55 (1919); in Spec. Rhodod. 468 (1930). — Tagg in Rhodod. Soc. Notes, iii. 230 (1928).

China. Yunnan: rochers de Tong-koua-pin, 3000 m., *E. E. Maire*, April 1912 (holotype).

Heliolepis Series

Rhododendron Leclerei in Fedde, Rep. Spec. Nov. xii. 284 (1913); Cat. Pl. Yun-Nan, 92 (1916). — Tagg in Rhodod. Soc. Notes, iii. 229 (1928). — Hutchinson in Spec. Rhodod. 326 (1930).

China. Yunnan: haut plateau de Ta-hai-tse, 3200 m., *E. E. Maire*, May 1912 (holotype).

Triflorum Series: Triflorum Subseries

Rhododendron lutescens Franchet in Bull. Soc. Bot. France, xxxiii. 235 (1886). — Hutchinson in Bot. Mag. cxlvi. t. 8851 (1920); in Spec. Rhodod. 789 (1930). — Tagg in Rhodod. Soc. Notes, iii. 228, 229 (1928).

Rhododendron Lemeei Léveillé in Fedde, Rep. Spec. Nov. xiii. 339 (1913); Cat. Pl. Yun-Nan, 92 (1916).

Rhododendron Blinii Léveillé in Bull. Géog. Bot. xxv. 21 (1915); Cat. Pl. Yun-Nan, 88 (1916).

China. Yunnan: monts de Ta-tchai, 3000 m., *E. E. Maire*, April 1913 (holotype of *Rh. Lemeei*); brousse de coteaux à Tchen-fong-tchan, 550 m., *E. E. Maire*, May 1912 (holotype of *Rh. Blinii*).

Rhododendron Lemeei and *Rh. Blinii* were first identified with *Rh. rubiginosum* by H. F. Tagg (l. c.).

TRIFLORUM Series: YUNNANENSE Subseries

Rhododendron tatsienense Franchet in Jour. de Bot. IX. 394 (1895). — Tagg in Rhodod. Soc. Notes, III. 230 (1928); in Spec. Rhodod. 853 (1930). — Hutchinson in Spec. Rhodod. 812 (1930).

Rhododendron tapelouense Léveillé in Bull. Géog. Bot. XXV. 20 (1915); Cat. Pl. Yun-Nan, 93 (1916).

CHINA. Yunnan: mont Ta-pé-lou, 3200 m., *E. E. Maire*, May 1912 (holotype of *Rh. tapelouense*).

Rhododendron tapelouense was first identified with *Rh. tatsienense* by Tagg (l. c.).

Rhododendron siderophyllum Franchet in Jour. de Bot. XII. 262 (1898). — Tagg in Rhodod. Soc. Notes, III. 229 (1928); in Spec. Rhodod. 852 (1928). — Hutchinson in Spec. Rhodod. 809 (1930).

Rhododendron Jahandiezii Léveillé in Fedde, Rep. Spec. Nov. XIII. 340 (1914); Cat. Pl. Yun-Nan, 92 (1916).

CHINA. Yunnan: flanc du Io-chan, 3200 m., *E. E. Maire*, May 1913 (holotype of *Rh. Jahandiezii*).

Rhododendron leucandrum Léveillé in Fedde, Rep. Spec. Nov. XII. 103 (1913); Fl. Kouy-Tchéou, 153 (1914). — Tagg in Rhodod. Soc. Notes, III. 229 (1928); in Spec. Rhodod. 852 (1930).

CHINA. Kweichou: Kiao-tche-che, *J. Cavalerie*, no. 1254, April 10, 1902 (holotype).

Rhododendron leucandrum is referred doubtfully to *Rh. siderophyllum* in Species of Rhododendron (l. c.), but it has an unusually elongated calyx and the lepidote scales are not the same in the two species. It is not exactly equivalent to any described species of the Triflorum Series and may stand till further material is available. It is founded on Cavalerie no. 1254 which is a mixed gathering; part of the material is named *Rh. Seguini* which is *Rh. Bodinieri*, but the remaining part is no doubt what Léveillé intended as *Rh. leucandrum*.

Rhododendron Bodinieri Franchet in Jour. de Bot. XII. 257 (1898). — Tagg in Rhodod. Soc. Notes, III. 230 (1928). — Hutchinson in Spec. Rhodod. 794 (1930).

Rhododendron rubro-punctatum Léveillé & Vaniot in Fedde, Rep. Spec. Nov. IX. 448 (1911); Fl. Kouy-Tchéou, 153 (1914).

Rhododendron Seguini Léveillé in Fedde, Rep. Spec. Nov. XIII. 148 (1914).

CHINA. Kweichou: Pin-fa, mont du Ouang-tse, *J. Cavalerie*, Sept. 1908 (holotype of *Rh. rubro-punctatum*); Kiao-tche-tche et Ganchouen, *J. Cavalerie*, no. 1254, April 10, 1902 (holotype of *Rh. Seguini*).

Rhododendron Seguini was referred to *Rh. rubro-punctatum* by Léveillé in his Flore du Kouy-Tchéou and both species were identified by Tagg (l. c.) with *Rh. Bodinieri.*

Rhododendron caeruleum Léveillé in Fedde, Rep. Spec. Nov. XII. 284 (1913); Cat. Pl. Yun-Nan, 89 (1916); Cat. Ill. Seu-Tchouen, pl. 25 (1918) MS. — Tagg in Rhodod. Soc. Notes, III. 228 (1928).

Rhododendron rarosquameum Balfour f. in Notes Bot. Gard. Edinb. X. 137 (1917).

Rhododendron eriandrum Léveillé apud Hutchinson in Spec. Rhodod. 798, 851 (1930).

CHINA. Yunnan: mont de Mo-tsou (fleuve Bleu), *E. E. Maire,* May 1912 (holotype of *Rh. caeruleum*); Niou-ko-tien-tien, *E. E. Maire,* May, 1911, "c. 60 cm. — 1 m., fl. violettes" (holotype of *Rh. eriandrum*).

In Species of Rhododendron *Rh. eriandrum* Lévl., a name appearing in Léveillé's handwriting on the specimen cited above, but remaining apparently unpublished, has been taken up as the valid name for this species, and *Rh. caeruleum* Lévl. referred to it as a doubtful synonym, but *Rh. caeruleum* is clearly the oldest name and doubtless identical with *Rh. rarosquameum* and *Rh. eriandrum.* The type of *Rh. caeruleum* is cited among the syntypes of *Rh. rarosquameum.*

LAPPONICUM Series

Rhododendron polycladum Franchet in Bull. Soc. Bot. France, XXXIII. 234 (1886). — Tagg in Rhodod. Soc. Notes, III. 230 (1928). — Hutchinson in Spec. Rhodod. 421, 853 (1930).

Rhododendron nanum Léveillé in Fedde, Rep. Spec. Nov. XII. 285 (1913); Cat. Pl. Yun-Nan, 92 (1916).

CHINA. Yunnan: haut plateau de Ta-hai-tse, 3200 m., *E. E. Maire,* May 1912 (holotype of *Rh. nanum*).

Rhododendron nanum was first referred to *Rh. polycladum* Franch. by Tagg (l. c.).

VACCINIOIDES Series

Rhododendron euonymifolium Léveillé in Fedde, Rep. Spec. Nov. XII. 103 (1913); Fl. Kouy-Tchéou, 152 (1914). — Tagg in Rhodod. Soc. Notes, III. 228 (1928). — Hutchinson in Spec. Rhodod. 820 (1930).

CHINA. Kweichou: Pin-fa, *J. Cavalerie,* no. 242, Aug. 21, 1902 (syntype); Hoa-ouay-jao, *J. Esquirol,* no. 661, Aug. 1905 (syntype).

This is apparently a valid species.

SCABRIFOLIUM Series

Rhododendron spinuliferum Franchet in Jour. de Bot. IX. 399

(1895). — Craib in Bot. Mag. CXXXVII. t. 8408 (1911). — Tagg in Rhodod. Soc. Notes, III. 229 (1928). — Hutchinson in Spec. Rhodod. 606, 852 (1930).

Rhododendron Duclouxii Léveillé in Bull. Soc. Agric. Sci. Sarthe, XXXIX. 46 (1903); Cat. Pl. Yun-Nan, 90 (1916).

Rhododendron fuchsiaeflora Léveillé in Fedde, Rep. Spec. Nov. XII. 284 (1913); Cat. Pl. Yun-Nan, 91 (1916), *"fuchsiiflora."* — Tagg in Rhodod. Soc. Notes, III. 229 (1928), *"fuchsiaeflorum,"* pro synon.

CHINA. Yunnan: environs de Yun-nan-sen, bois de la pagode de Kiong-tchou-se et de celle de Hé-long-tan, *E. Bodinier*, no. 115, Feb. 24 and March 2, 1897 "petit arbuste, fleurs pourpres" (syntypes of *Rh. Duclouxii*); Yun-nan-sen, c. dans la montagne près du College, *F. Ducloux*, no. 61, "petit arbuste à fleurs rose-pourpres, premières fleurs 29 janv. 1897" (syntype of *Rh. Duclouxii*); montagnes arides de Mo-tsou (fleuve Bleu), 800 m., *E. E. Maire*, May 1912 (holotype of *Rh. fuchsiaeflora*).

Rhododendron fuchsiaeflora was first identified with *Rh. spinuliferum* in Species of Rhododendron (p. 852). Also *Rh. Duclouxii* was referred as a synonym to that species by Hutchinson (op. cit. p. 606), but according to Handel-Mazzetti (in litt.) it represents a hybrid between *Rh. spiciferum* Franch. and *Rh. spinuliferum* Franch. which he states is not rare around Yunnanfu. Handel-Mazzetti saw a type specimen of *Rh. Duclouxii* in the Berlin Herbarium, which was recognized also by Diels as the hybrid indicated. It may be doubted, if all the syntypes cited above represent this hybrid, and therefore, for the present *Rh. Duclouxii* is kept as a synonym of *Rh. spinuliferum* Franch., until the material in Edinburgh has been revised.

Sect. 3. RHODORASTRUM Maxim.

VIRGATUM Series

Rhododendron racemosum Franchet in Bull. Soc. Bot. France, XXXIII. 235 (1886). — Hooker f. in Bot. Mag. XXIX. t. 7301 (1893). — Tagg in Rhodod. Soc. Notes, III. 228, 230 (1928). — Hutchinson in Spec. Rhodod. 829, 852, 853 (1930).

Rhododendron motsouense Léveillé in Fedde, Rep. Spec. Nov. XIII. 148 (1914) "motsonense"; Cat. Pl. Yun-Nan, 92 (1916).

Rhododendron crenatum Léveillé in Bull. Géog. Bot. XXV. 20 (1915); Cat. Pl. Yun-Nan, 89, fig. 22 (1916).

CHINA. Yunnan: montagnes aux environs de Mo-tsou (fleuve Bleu), 800 m., Ta-hai-tse, 3200 m., *E. E. Maire*, 1911-1912 (syntypes of *Rh. motsuense*); monts derrière Mo-tsou, 3000 m., *E. E. Maire*, April 1911 (holotype of *Rh. crenatum*).

Rhododendron motsouense and *Rh. crenatum* were first referred to *Rh. racemosum* by Tagg (l. c.).

DAURICUM Series

Rhododendron mucronulatum Turczaninow in Bull. Soc. Nat. Moscow, x. no. 7, p. 155 (1837). — Nakai, Pl. Sylv. Kor. VIII. 35, t. 10 (1919).

Rhododendron dauricum L. var. *mucronulatum* (Turcz.) Maximowicz in Mém. Acad. Sci. St. Pétersb. sér. 7, XVI. no. 9, p. 44 (Rhod. As. Or.) (1870). — Tagg in Rhodod. Soc. Notes, III. 231 (1928); in Spec. Rhodod. 853 (1930).

Rhododendron Taquetii Léveillé in Fedde, Rep. Spec. Nov. XII. 101 (1913).

KOREA. Quelpaert: Hallaisan, *E. Taquet,* no. 5788, June 1911 (holotype of *Rh. Taquetii*).

Rhododendron Taquetii was first referred to *Rh. mucronulatum* by Nakai (l. c.).

Subgen. II. **AZALEASTRUM** Planch.

Sect. 1. EUAZALEASTRUM Wils.

OVATUM Series

Rhododendron Bachii Léveillé in Fedde, Rep. Spec. Nov. XII. 102 (1913); Fl. Kouy-Tchéou, 152 (1914). — Tagg in Rhodod. Soc. Notes, III. 227 (1928). — Hutchinson in Spec. Rhodod. 561 (1930).

CHINA. Kweichou: Lou-mong-touan, RR., *J. Cavalerie,* no. 2982, May 1908 (holotype).

This is apparently a valid species and closely related to *Rh. ovatum* Maxim. and *Rh. leptothrium* Balf. f. & Forr.

Sect. 2. CHIONASTRUM Franch.

STAMINEUM Series

Rhododendron stamineum Franchet in Bull. Soc. Bot. France, XXXIII. 236 (1886). — Hutchinson in Bot. Mag. CXLI. t. 8601 (1915); in Spec. Rhodod. 623 (1930).

Rhododendron Cavaleriei var. *Chaffanjoni* Léveillé in Bull. Soc. Agric. Sci. Sarthe, XXXIX. 49 (1903); Fl. Kouy-Tchéou, 152 (1914).

Rhododendron Chaffanjonii Léveillé ex Hutchinson in Spec. Rhodod. 623 (1930), pro synon. *Rh. staminei.*

CHINA. Kweichou: environs de Kouy-yang, mont du Collège, *J. Chaffanjon* in Hb. *Bodinier,* no. 2332, April 1898 (holotype of *Rh. Cavaleriei* var. *Chaffanjoni*).

Rhododendron Cavaleriei var. *Chaffanjoni* was first identified with *Rh. stamineum* by Hutchinson in 1930 (l. c.), but he cited it as *Rh. Chaffanjonii.*

Rhododendron Esquirolii Léveillé in Fedde, Rep. Spec. Nov. XII. 102 (1913). — Tagg in Rhodod. Soc. Notes, III. 228 (1928). — Hutchinson in Spec. Rhodod. 614 (1930).

CHINA. K w e i c h o u : hautes montagnes, *J. Cavalerie,* no. 2375, and *J. Esquirol,* no. 476, June 1905 (syntypes).

Rhododendron Cavaleriei Léveillé in Bull. Soc. Agric. Sci. Sarthe, XXXIX. 48 (1903); Fl. Kouy-Tchéou, 152 (1914). — Tagg in Rhodod. Soc. Notes, III. 228 (1928). — Hutchinson in Spec. Rhodod. 612 (1930).

?*Reevesia Esquirolii* Léveillé in Fedde, Rep. Spec. Nov. XIII. 175 (1914); Fl. Kouy-Tchéou, 405 (1915).

CHINA. K w e i c h o u : sous-prefecture de Tou-chan, *J. Cavalerie,* no. 2633, May 1899 (holotype of *Rh. Cavaleriei*); bois de Bangnin, *J. Esquirol,* no. 2604, Feb. 29, 1912 (holotype of *Reevesia Esquirolii*).

Dr. J. M. Cowan states in a letter of April 24, 1934, that Esquirol no. 2604 is probably identical with *Rh. Cavaleriei,* but the material is poor.

Reevesia Esquirolii is enumerated by J. Anthony in his paper, "The genus Reevesia Lindl." (in Notes Bot. Gard. Edinb. XV. 121-129, 1926) as an excluded species representing a species of *Rhododendron* of the Stamineum section.

Subgen. III. **ANTHODENDRON** Endl.

Sect. TSUTSUTSI

(AZALEA Series: OBTUSUM Subseries)

Rhododendron chrysocalyx Léveillé & Vaniot in Fedde, Rep. Spec. Nov. II. 113 (1906); Fl. Kouy-Tchéou, 152 (1914). — Wilson in Jour. Arnold Arb. VI. 200 (1925). — Tagg in Rhodod. Soc. Notes, III. 228 (1928).

Rhododendron spinigerum Léveillé in Bull. Géog. Bot. XXIV. 251 (1914).

CHINA. K w e i c h o u : route de Mou-you-se à Tcheu-lin, *J. Cavalerie,* no. 2059, June 1904 (syntype of *Rh. chrysocalyx*); Pin-fa, bord des ruisseaux, *J. Cavalerie,* no. 1796, April 25, 1904 (syntype of *Rh. chrysocalyx*); ilêt à Pia-ouay-ho, 700 m., *J. Esquirol,* no. 3560, May 2, 1912 (holotype of *Rh. spinigerum*).

Rhododendron spinigerum was referred to *Rh. chrysocalyx* as a synonym by Léveillé in his Flore du Kouy-Tchéou.

Rhododendron fuchsiifolium Léveillé in Fedde, Rep. Spec. Nov. XIII. 148 (1914); Fl. Kouy-Tchéou, 152 (1914); *"fuchsiifolia".* — Tagg in Rhodod. Soc. Notes, III. 229 (1928); in Spec. Rhodod. 852 (1930).

China. Kweichou: Pin-fa, *J. Cavalerie,* no. 3221, May 20, 1907 "fl. blanc-rose, piquetées de pourpre" (holotype; photo. in A. A.).

This species is closely related to *Rh. microphytum* Franch., but differs in the corolla having outside 5 rows of stipitate glands extending from the base to about the middle of the lobes, while in *Rh. microphyton* the corolla is perfectly glabrous outside. The leaves are elliptic-ovate, acute or acuminate, rather densely strigose above, below only with flattened strigose hairs on the midrib, otherwise glabrous; in *Rh. microphyton* there are scattered red-brown hairs on the whole underside, rarely it is nearly glabrous, and the shape and size of the leaves is exceedingly variable, sometimes even broadest above the middle and obtusish.—A. R.

Rhododendron umbelliferum Léveillé in Fedde, Rep. Spec. Nov. XII. 102 (1913); Fl. Kouy-Tchéou, 153 (1914); Cat. Pl. Yun-Nan, 94 (1916). — Tagg in Rhodod. Soc. Notes, III. 231 (1928); in Spec. Rhodod. 853 (1930).

China. Kweichou: Pin-fa, *J. Cavalerie,* no. 10, Apr. 2, 1902 (holotype, ex Léveillé; isotype in Hb. Léveillé and photo. of isotype in A. A.).

Of this species I have not seen the original specimen. The specimen from the Herbarium Léveillé before me is apparently a duplicate of Cavalerie no. 10 received from Kew with a copied label. This specimen consists of two branches; the larger one is *Rh. Mariesii* Hemsl., while the smaller branch seems to agree with Léveillé's rather poor description of *Rh. umbelliferum.* I am not able to refer this specimen to any described species; it seems nearest to *Rh. microphyton* Franch., but the corolla-tube is much shorter than the oblong lobes and in the two flowers examined I counted 7 stamens shorter than the lobes.—A. R.

Rhododendron yedoense Maxim. var. **poukhanense** (Lévl.) Nakai in Tokyo Bot. Mag. XXXIV. (274) (1920). — Rehder in Spec. Rhodod. 109 (1930).

Rhododendron poukhanense Léveillé in Fedde, Rep. Spec. Nov. v. 100 (1908). — Nakai, Fl. Sylv. Kor. VIII. 47, t. 18 (1919). — Tagg in Rhodod. Soc. Notes, III. 229 (1928).

Rhododendron hallaisanense Léveillé in Fedde, Rep. Spec. Nov. XII. 101 (1913).

Korea. Keiki Prov.: in arce Pouk-han, *U. Faurie,* June 3, 1901 (holotype of *Rh. poukhanense*). Quelpaert: Hallaisan, 1800 m., *E. Taquet,* no. 305, Oct. 1907 (holotype of *Rh. hallaisanense*).

Rhododendron hallaisanense was first identified with *Rh. poukhanense* by Nakai in 1919 (l. c.).

Rhododendron mucronatum (Bl.) G. Don, Gen. Syst. III. 846 (1834). — Tagg in Spec. Rhodod. 851 (1930).

Rhododendron Argyi Léveillé in Fedde, Rep. Spec. Nov. XII. 102 (1913); in Mem. Acad. Ci. Art. Barcelona, ser. 3, XII. 550 (Cat. Pl. Kiang-Sou, 10) (1916).

CHINA. K i a n g s u : Long-se, Long-chien, Vou-sée, *Ch. d'Argy*, Apr. 20 [1861-74] (holotype of *Rh. Argyi*).

Rhododendron Argyi was first identified with *Rh. mucronatum* in 1920 by E. H. Wilson in Léveillé's herbarium, but in 1925 (Jour. Arnold Arb. VI. 174) he published it as a synonym of *Rh. dauricum* var. *mucronulatum;* this mistake was apparently brought about by the similarity in the name and the misreading of the notes he made in Edinburgh.

SPECIES DUBIAE

Rhododendron Feddei Léveillé in Fedde, Rep. Spec. Nov. XII. 102 (1913); Fl. Kouy-Tchéou, 152 (1914). — Tagg in Rhodod. Soc. Notes, III. 229 (1928); Hutchinson in Spec. Rhodod. 611 (1930).

CHINA. K w e i c h o u : Pin-fa, précipices, *J. Cavalerie*, no. 1074, June 18, 1903, "arbrisseau 3-4 m." (holotype).

Rhododendron Feddei is probably equivalent to one of the described species of the Stamineum Series, but the material is too imperfect for determination and the name should be ignored.

Rhododendron Maximowiczianum Léveillé in Bull. Soc. Agric. Sci. Sarthe, XXXIX. 47 (1903) Cat. Pl. Yun-Nan, 92 (1916). — Tagg in Spec. Rhodod. 852 (1930).

CHINA. Y u n n a n : environs de Yunnan-sen, acheté à marché de la ville, apporté des montagnes voisines, *E. Bodinier*, March 20, 1897 "arbuste" (holotype).

This is said by the author to be near *Rh. siderophyllum* Franch., but the fragmentary specimens are those of a member of the Irroratum Series. The indumentum described by the author is not present in the specimens presumed to be the originals. The species should most fittingly be ignored.

Enkianthus Dunnii Léveillé in Fedde, Rep. Spec. Nov. IX. 448 (1911); Fl. Kouy-Tchéou, 148 (1914). — Hutchinson in Notes Bot. Gard. Edinb. XI. 167 (1919).

Enkianthus Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. IX. 448 (1911). — **Synon. nov.**

?*Enkianthus xanthoxantha* Léveillé in Fedde, Rep. Spec. Nov. IX. 448 (1911) "xantoxantha"; Fl. Kouy-Tchéou, 148 (1914). — **Synon. nov.**

China. Kweichou: Pin-fa, *J. Cavalerie,* no. 2300, Apr. 13, 1905 (holotype of *E. Dunnii;* photo. in A. A.); Pin-fa, sommet rocheux des montagnes, *J. Cavalerie,* no. 7, Apr. 2, 1902 (holotype of *E. Cavaleriei;* photo. in A. A.); Pin-fa, montagnes, *J. Cavalerie,* no. 930, "fleurs jaunes" (holotype of *E. xanthoxantha;* photo. in A. A.).

Enkianthus Dunnii and *E. Cavaleriei* are doubtless identical. Of *E. xanthoxantha* the collector gives the color of the flowers as yellow and if this is true it may be a distinct color-form or another species; the leaves are still undeveloped and therefore cannot be compared with those of the other specimens. *Enkianthus Dunnii* is closely related to *E. quinqueflorus* Lour. as already stated by Hutchinson (l. c.) but differs in the thinner chartaceous, not reticulate leaves, slenderer petioles, smaller flowers and lanceolate sepals. From *E. serrulatus* (Wils.) Schneid. it is easily distinguished by the not reticulate leaves with an entire cartilagineous margin, or above the middle indistinctly and remotely denticulate, as they are often in *E. quinqueflorus. Enkianthus Cavaleriei* is referred by Léveillé in his Flore du Kouy-Tchéou as a synonym to *E. cerasiflora,* but this is apparently a mistake, for it is quite different from that species.

Enkianthus chinensis Franchet in Jour. de Bot. ix. 371 (1895). — Léveillé, Cat. Pl. Yun-Nan, 86 (1916).

Zenobia cerasiflora Léveillé in Bull. Acad. Intern. Géog. Bot. xii. 253 (1903).

Enkianthus cerasiflora Léveillé in Fedde, Rep. Spec. Nov. ix. 448 (1911); Fl. Kouy-Tchéou, 148 (1914). — Craib in Notes Bot. Gard. Edinb. xi. 167 (1919). — **Synon. nov.**

Bodinierella Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. xii. 101 (1913); Fl. Kouy-Tchéou, 147 (1914).

Enkianthus Leveillcanus Craib in Notes Bot. Gard. Edinb. xi. 168 (1919). — **Synon. nov.**

China. Kweichou: Tang-kio-chan, *E. Bodinier,* May 20, 1900 (holotype of *Zenobia cerasiflora;* photo. and merotype in A. A.); Pin-fa, Jouin-ou-chan, hautes montagnes, *J. Cavalerie,* no. 61, July 15, 1902 (syntype of *Bodinierella Cavaleriei;* photo. in A. A.), no. 1318, June 3, 1902, "fleurs venées, lavées de rose" (syntype of *Bodinierella Cavaleriei;* photo. in A. A.).

Craib refers *E. cerasiflorus* to the Campanulatus Series on account of its glabrous style, but in *E. chinensis* the style may vary from more or less pilose to glabrous; I find the style glabrous in Bock & Rosthorn no. 2080, Wilson nos. 3547 and 3549 and nearly glabrous in Wilson no. 1002; in the type of *Bodinierella Cavaleriei* the style is very sparingly pilose. I therefore do not believe that the glabrousness of the style can

be relied upon to distinguish *E. campanulatus* (Miq.) Nichols. *Bodinierella Cavaleriei* does not seem to be specifically distinct from *E. chinensis*, though the leaves and flowers are generally smaller. Craib in transferring it to *Enkianthus* under a new specific epithet does not discuss its relationship.

Cassiope selaginoides Hooker f. & Thompson in Hooker's Kew Jour. Bot. VII. 126, t. 4 (1885). — Léveillé, Cat. Pl. Yun-Nan, 86 (1915).

Cassiope Mairei Léveillé in Fedde, Rep. Spec. Nov. XIII. 342 (1914); Cat. Pl. Yun-Nan, 86 (1915). — **Synon. nov.**

CHINA. Yunnan: sur rochers du Io-chan, 3200 m., *E. E. Maire*, June 1913 (holotype of *C. Mairei;* photo. and merotype in A. A.).

Leucothoë spec.

Pieris Cavaleriei Léveillé & Vaniot in Bull. Soc. Bot. France, LI. 292 (1904); LIII. 205 (1906); Fl. Kouy-Tchéou, 149 (1914).

CHINA. Kweichou: Pin-fa, chutes d'eau, précipes, *J. Cavalerie*, no. 780, Oct. 15, 1902 (holotype of *Pieris Cavaleriei;* photo. in A. A.).

This is apparently closely related to *L. Griffithiana* (Hook. f.) Clarke which differs according to the description in the subobtuse calyx-teeth, ovate and abruptly short-acuminate or acute in Cavalerie's specimen which is in young fruit. I have seen no material of *L. Griffithiana;* the difference in the shape of the calyx-teeth may not be as great as it seems and Cavalerie's specimen may be referable to *L. Griffithiana.*

Pieris formosa (Wall.) D. Don in Edinb. N. Philos. Jour. XVII. 159 (1834). — Léveillé, Cat. Pl. Yun-Nan, 87 (1916).

Pieris Bodinieri Léveillé in Bull. Acad. Intern. Géog. Bot. XII. 253 (1903); Bull. Soc. Bot. France, LIII. 205 (1906); Fl. Kouy-Tchéou, 149 (1914); Cat. Pl. Yun-Nan, 87 (1916); Cat. Ill. Pl. Seu-Tchouen, pl. 24 (1918), MS. — **Synon. nov.**

CHINA. Kweichou: Pin-fa, *J. Cavalerie*, no. 9, April 2, 1902 (cited under *P. Bodinieri* in Fl. Kouy-Tchéou, l. c., together with no. 64; photo. in A. A.). Yunnan: environs de Yunnan-sen, c. dans la montagne, *E. Bodinier*, no. 60, Jan. 29, 1897 "arbuste, fl. blanches" (syntype of *P. Bodinieri;* ex Léveillé); *Fr. Ducloux*, March 9, 1893 (syntype of *P. Bodinieri;* ex Léveillé).

Pieris Bodinieri is at present represented in the Herbarium only by Cavalerie no. 9, while the two syntypes from Yunnan cannot be located. The species seems common in Yunnan and from Kweichou I have seen specimens collected by Y. Tsiang (no. 9369) and by Steward, Chiao and Cheo (no. 759).

Xolisma ovalifolia (Wall.) Rehder in Jour. Arnold Arb. v. 52 (1924).

Pieris ovalifolia (Wall.) D. Don in Edinb. Phil. Jour. xvii. 159 (1834). — Léveillé, Fl. Kouy-Tchéou, 150 (1914); Cat. Pl. Yun-Nan, 87 (1916).

Pieris Ulbrichii Léveillé in Bull. Soc. Bot. France, liii. 205 (1906); Fl. Kouy-Tchéou, 150 (1914) *"Ulbrichiana."* — **Synon. nov.**

Pieris Mairei Léveillé in Bull. Géog. Bot. xxv. 21 (1915); Cat. Pl. Yun-Nan, 87 (1916). — **Synon. nov.**

Vaccinium Mairei Léveillé, l. c. (1915); l. c. (1916).

China. Kweichou: without precise locality, *J. Esquirol*, no. 42, May 15, 1904 "arbrisseau, fleurs blanches" (holotype of *P. Ulbrichii;* photo. in A. A.). Yunnan: collines calcaires de Tcha-ho, 2600 m., *E. E. Maire*, July 1912 "arbuste peu rameux, haut 1.30 m., fleurs blanches" (holotype of *Pieris Mairei;* photo. in A. A.); brousse des montagnes à Kiao-me-ti, *E. E. Maire*, May 1912 (holotype of *Vaccinium Mairei;* merotype in A. A.).

Pieris Ulbrichii and *P. Mairei* had been referred already by J. Hutchinson to *P. ovalifolia* according to notes on the type sheets.

Xolisma ovalifolia var. **lanceolata** (Wall.) Rehder in Jour. Arnold Arb. v. 52 (1924).

Pieris ovalifolia var. *lanceolata* (Wall.) Clarke in Hook. f., Fl. Brit. Ind. iii. 461 (1882). — Léveillé, Cat. Pl. Yun-Nan, 87 (1916).

Pieris kouyangensis Léveillé in Bull. Acad. Intern. Géog. Bot. xii. 253 (1903); in Bull. Soc. Bot. France, liii. 204 (1906); Fl. Kouy-Tchéou, 149 (1914); Cat. Pl. Yun-Nan, 87 (1916). — **Synon. nov.**

Pieris Mairei var. *parvifolia* Léveillé in Bull. Géog. Bot. xxv. 21 (1915); Cat. Pl. Yun-Nan, 87 (1916).

China. Kweichou: environs de Kouy-yang, c. sur les montagnes du Collège, *E. Bodinier*, no. 2264, May 18, 1898 "petit arbuste, 0.50 m., fleurs blanches" (holotype of *P. kouyangensis;* photo. in A. A.); collines arides de Tché-hai, 2500 m., *E. E. Maire*, June 1912 (holotype of *P. Mairei* var. *parvifolia;* photo. in A. A.).

Pieris kouyangensis and *P. Mairei* var. *parvifolia* have been referred to *P. ovalifolia* D. Don by J. Hutchinson. *Pieris Mairei* var. *parvifolia* represents a small-leaved form of var. *lanceolata*.

Xolisma villosa (Wall.) Rehd. var. **pubescens** (Franch.) Rehder in Jour. Arnold Arb. v. 53 (1924).

Pieris Henryi Léveillé in Bull. Soc. Bot. France, liii. 204 (1906); Cat. Pl. Yun-Nan, 87 (1916). — Rehder, l. c. 54 (1924). — **Synon. nov.**

China. Yunnan: Mengtze, mountains 6500 ft., *A. Henry*, no.

9681 "low shrub, 1 ft. high, flowers white" (holotype of *P. Henryi;* photo. in A. A.).

Pieris Henryi was referred by J. Hutchinson to *P. ovalifolia* according to a note on the type sheet. Judging only from Léveillé's description it was placed by me (l. c. 53, 54) tentatively under *X. villosa,* but the pubescent ovary shows that it belongs to var. *pubescens.*

Gaultheria yunnanensis (Franch.), comb. nov.

Vaccinium yunnanense Franchet in Jour. de Bot. IX. 368 (1895).

Gaultheria laxiflora Diels in Bot. Jahrb. XXIX. 515 (1900). — **Synon. nov.**

Pieris Fortunati Léveillé in Bull. Soc. Bot. France, LIV. 369 (1907); Fl. Kouy-Tchéou, 149 (1914); Cat. Pl. Yun-Nan, 87 (1916). — **Synon. nov.**

Pieris vaccinium Léveillé in Fedde, Rep. Spec. Nov. IX. 448 (1911). — **Synon. nov.**

Vaccinium yunnanense Franch. var. *Franchetiana* Léveillé, Fl. Kouy-Tchéou, 155 (1914). — **Synon. nov.**

Embelia Vaniotii Léveillé, Fl. Kouy-Tchéou, 285 (1915). — **Synon. nov.**

CHINA. Kweichou: without precise locality, no. 666 (holotype of *Pieris Fortunati;* photo. in A. A.); montagnes de Lou-tsong-koan, c. dans les pentes boisées, *E. Bodinier,* no. 1659, June 12, 1897 "petit arbuste ou sous-arbrisseau, fl. blanches" (syntype of *Pieris vaccinium* and *Vaccinium yunnanense* var. *Franchetiana;* photo. in A. A.); environs de Gan-pin dans la montagne, *L. Martin,* July 28, 1898 (syntype of *Pieris vaccinium* and *V. yunnanense* var. *Franchetiana;* photo. in A. A.); moulins de Tong-tchéou, *J. Esquirol,* no. 3251, June 22, 1902 (holotype of *Embelia Vanioti;* photo. in A. A.). Yunnan: dans les bois à Tchen-fong-chan, *J. M. Delavay,* no. 3069, July 1894 "arbrisseau, fleurs blanches" (holotype of *V. yunnanense* in hb. Paris; photo. in A. A.).

It is evident from Franchet's description of his *Vaccinium yunnanense* that the plant can not belong to *Vaccinium,* for he describes the fruit (immature) as "capsula semi-inclusa globoso-depressa, tomentella."

Pieris Vaccinium was not mentioned as a synonym when Léveillé enumerated the two specimens on which this species was based under the new name *Vaccinium yunnanense* var. *Franchetiana* without description.

Vaccinium bracteatum Thunberg, Fl. Jap. 156 (1784). — Rehder & Wilson in Sargent, Pl. Wilson. I. 558 (1913). — Léveillé, Fl. Kouy-Tchéou, 154 (1914). — Nakai, Fl. Sylv. Kor. VIII. 58 (1919).

Pieris divaricata in Bull. Acad. Intern. Géog. Bot. XII. 252 (1903); in Bull. Soc. Bot. France, LIII. 206 (1906). — **Synon. nov.**

Pieris coreana Léveillé in Fedde, Rep. Spec. Nov. v. 281 (1908). — **Synon. nov.**

Pieris Fauriei Léveillé, l. c. (1908). — **Synon. nov.**

Vaccinium Taquetii Léveillé in Fedde, Rep. Spec. Nov. XII. 182 (1913).

KOREA. Quelpaert: secus torrentes, *U. Faurie*, no. 1866, July 1907 (holotype of *Pieris coreana;* photo. and isotype in A. A.); in petrosis silvarum, *U. Faurie*, no. 1865, June 1907 (holotype of *P. Fauriei;* photo. and isotype in A. A.); in silvis Hioton, *E. Taquet*, no. 1084, Oct. 1908 (holotype of *V. Taquetii;* photo. and isotype in A. A.).

CHINA. Kweichou: environs de Kouy-yang, bois de Kien-lin-chan, *E. Bodinier*, no. 2399, July 7, 1898, "grand arbuste, quelquefois petit arbre, branches très cassantes, fl. blanches, parfois legèrement rosées" (holotype of *Pieris divaricata;* photo. in A. A.).

Pieris divaricata, *P. coreana* and *P. Fauriei* have been already referred to *V. bracteatum* by W. E. Evans according to notes on the type sheets. *Vaccinium Taquetii* is enumerated as a synonym of *V. bracteatum* by Nakai (l. c.).

Vaccinium repens (Lévl.), comb. nov.

Pieris repens Léveillé in Bull. Acad. Intern. Géog. Bot. XII. 252 (1903); in Bull. Soc. Bot. France, LIII. 205 (1906); Fl. Kouy-Tchéou, 150 (1914); Cat. Pl. Yun-Nan, 87 (1916).

Vaccinium mekongense W. W. Smith in Notes Bot. Gard. Edinb. IX. 133 (1916). — **Synon. nov.**

CHINA. Kweichou: montagnes entre Hin-y-fou et le fleuve Hoa-kiang, partie haute de la montagne, *E. Bodinier*, no. 1560, Apr. 20, 1897 "très petit arbuste, fleurs d'un blanc pourpré" (holotype of *P. repens;* photo. in A. A.). Yunnan: open situations on the Yung-chang—Mekong divide, Lat. 25° 15′ n., alt. 7-8000 ft., *G. Forrest*, no. 9887, May 1913, shrub of 2-5 ft., flowers creamy white, striped rose (holotype of *V. mekongense;* isotype in A. A.).

I am unable to find any characters to separate the two specimens cited above, even in the habit there is not much difference. The term "repens" applied by Léveillé to his species is misleading; the specimen clearly represents an upright shrub, about 20 cm. tall, without any sign of being creeping except the curved root-stock.

Vaccinium albidens Léveillé & Vaniot in Fedde, Rep. Spec. Nov. IX. 447 (1911); Fl. Kouy-Tchéou, 154 (1914).

CHINA. Kweichou: without precise locality, *J. Esquirol*, no. 379, June 1902 (holotype; photo. in A. A.).

The specimen is too incomplete to allow exact identification; the

small apparently immature fruits are short-stalked and borne in short rather dense racemes. Judging from the foliage it seems related to *V. Griffithianum* Wight, though the leaves are smaller than usually in that species.

Vaccinium mandarinorum Diels in Bot. Jahrb. XXIX. 516 (1901).— Metcalf in Jour. Arnold Arb. XII. 272 (1931).

Vaccinium Donianum Maximowicz in Mél. Biol. I. 608 (1872); in Bull. Acad. Sci. St. Pétersb. XVIII. 43 (1873), pro parte.

Pieris longicornu Léveillé & Vaniot in Bull. Soc. Bot. France, LI. 291 (1904); LIII. 206 (1906). — Léveillé, Fl. Kouy-Tchéou, 149 (1914).

Pieris Esquirolii Léveillé & Vaniot in Bull. Soc. Bot. France, LIII. 206 (1906). — Léveillé, Fl. Kouy-Tchéou, 149 (1914). — **Synon. nov.**

Pieris Esquirolii var. *discolor* Léveillé & Vaniot, l. c. (1906).

CHINA. K w e i c h o u : Pin-fa, montagnes, *J. Cavalerie,* no. 1009, May 14, 1903, "1 à 2 m., fleurs blanches, étamines jaunes" (holotype of *Pieris longicornu;* photo. in A. A.); route de So-jao, face à Pa-pen, *J. Esquirol,* no. 12, April 3, 1904 (holotype of *P. Esquirolii;* photo. in A. A.); same locality, coteaux schisteux, *J. Esquirol,* nos. 10 and 13, April 3 and 4, 1904, "arbrisseau de 2 à 3 m., fl. blanc-rouge, sépales rougeâtres" (syntypes of *Pieris Esquirolii* var. *discolor;* photo. in A. A.).

Vaccinium mandarinorum is here accepted as a distinct species following Metcalf (l. c.), and this is now also the opinion of Dr. Handel-Mazzetti (in litt.) who referred, in Akad. Anzeig. Wiss. Wien. 1925, p. 146 (Pl. Nov. Sin. Forts. 35, p. 43), *Pieris longicornu* to *Vaccinium Donnianum,* while Anthony (Not. Bot. Gard. Edinb. XVIII. 16. 1933) is inclined to consider it specifically distinct. *Pieris Esquirolii* var. *discolor* represents a form with the leaves pubescent beneath; in one of the specimens, no. 13, the whole under-side is sparingly villous, more densely so in the veins, while in no. 10 only the midrib below the middle and the petiole is villous, a character also occasionally observed in otherwise typical *V. mandarinorum.*

Vaccinium Duclouxii (Lévl.) Handel-Mazzetti in Akad. Anz. Wiss. Wien, 1925, p. 146 (Pl. Nov. Sin. Forts. 35, p. 4) (1925).

Pieris Duclouxii Léveillé in Bull. Acad. Intern. Géog. Bot. XII. 253 (1903); in Bull. Soc. Bot. France, LIII. 206 (1906); Cat. Pl. Yun-Nan, 87 (1916).

Vaccinium Forrestii Diels in Not. Bot. Gard. Edinb. v. 294 (1912).

CHINA. Y u n n a n : environs de Yun-nan-sen, bois de la pagode de Kiong-chou-se, *E. Bodinier,* no. 104, March 2, 1897, "grand arbuste de 2-3 m." (holotype of *Pieris Duclouxii;* photo. in A. A.); on the

same label the following additional localities are cited: "item à My-tsao, 6 mars 97, *Fr. Ducloux;* item mont Ma-kay, 4 April 97," but there is only one specimen on the sheet.

Anthony (Notes Bot. Gard. Edinb. XVIII. 16. 1933) refers *V. Duclouxii* as a synonym to *V. Donnianum* Wight, but it is easily distinguished from typical *V. Donnianum* by its rather short racemes and very short pedicels and the non-ciliate calyx, or ciliate only at the apex.

Vaccinium pubicalyx Franchet in Jour. de Bot. IX. 369 (1895). — Léveillé, Cat. Pl. Yun-Nan, 94 (1916).

Myrica Mairei Léveillé in Bull. Géog. Bot. XXV. 40 (1915); Cat. Pl. Yun-Nan, 177 (1915). — **Synon. nov.**

CHINA. Yunnan: brousse des montagnes à Kiao-me-ti, 3100 m., *E. E. Maire,* July 1912 "petit arbre peu rameux, fleurs jaunes" (holotype of *Myrica Mairei;* merotype in A. A.).

Maire gives the color of the flowers as yellow; in his specimen the flowers are still in bud and may be yellowish in that state, but the open flowers are white or pinkish white according to Handel-Mazzetti (no. 10129) and Rock (no. 5075).

Vaccinium pubicalyx var. **leucocalyx** (Lévl.) comb. nov.

Pieris Esquirolii Lévl. var. *leucocalyx* Léveillé in Bull. Soc. Bot. France, LIII. 206 (1906).

CHINA. Kweichou: route de So-Jao, face à Pa-pen, *J. Esquirol,* no. 11, 1904 "presque entièrement rouge, calice coloré" (holotype of *Pieris Esquirolii* var. *leucocalyx;* photo. in A. A.).

Pieris Esquirolii var. *leucocalyx* is perhaps best referred to *Vaccinium pubicalyx* Franch., with which it agrees in the pubescent calyx and the dense rather short racemes, but it differs in the leaves being only short-acuminate or acute and loosely villous on the under surface, more densely so on the midrib, and in the longer 2-4 cm. long racemes. In Flore du Kouy-Tchéou, Léveillé cites Esquirol no. 11 under *Pieris Esquirolii* without mentioning the varietal name.

Vaccinium malaccense Wight in Calcutta Jour. Nat. Hist. VIII. 172 (1847).

Pieris ovalifolia var. *denticulata* Léveillé in Bull. Soc. Bot. France, LI. 291 (1904).

Pieris lucida Léveillé, op. cit. LIII. 207 (1906); Fl. Kouy-Tchéou, 150 (1914). — **Synon. nov.**

CHINA. Kweichou: Tsin-gai (Kai-po), *J. Cavalerie* no. 1235, Aug. 5, 1903, "h. 3 à 4 m." (holotype of *Pieris ovalifolia* var. *denticulata* and *P. lucida;* photo. in A. A.).

Pieris lucida has been identified by Hutchinson as *Vaccinium malaccense.*

Vaccinium Dunalianum Wight var. **urophyllum** Rehder & Wilson in Sargent, Pl. Wilson. I. 560 (1913). — Léveillé, Cat. Pl. Yun-Nan, 94 (1916).

Pieris Martini Léveillé in Bull. Acad. Intern. Bot. Géog. XII. 252 (1903); in Bull. Soc. Bot. France, LIII. 204 (1906); Fl. Kouy-Tchéou, 150 (1914). — **Synon. nov.**

CHINA. K w e i c h o u : environs de Gan-pin, mont de la ville, *L. Martin* in hb. *Bodinier*, no. 2308, June 5, 1898 "arbuste à fleurs blanches teintées de rose" (holotype of *Pieris Martini;* photo. in A. A.).

On account of the short-villous branchlets and petioles *Pieris Martini* is referable to var. *urophyllum* of *V. Dunalianum*, but the midrib and veins of the under side of the leaves are glabrous and thus the specimen represents a transition to the typical form. According to a note on the type sheet it was referred to *V. urceolatum* Hemsl., but that species is easily distinguished even without flowers by its short-petioled almost subsessile leaves rounded at the base.

Vaccinium foetidissimum Léveillé & Vaniot in Fedde, Rep. Spec. Nov. IX. 447 (1911); Fl. Kouy-Tchéou, 154 (1914).

Anisophyllea Cavalerici Léveillé, Fl. Kouy-Tchéou, 344 (1915). — **Synon. nov.**

CHINA. K w e i c h o u : Niang-ouang, rocailles près ruisseau du Chang, rare, *J. Cavalerie*, no. 343, Oct. 15, 1907 "fruit violet-cendré, très puant" (holotype of *V. foetidissimum;* merotype in A. A.); Pin-fa, *J. Cavalerie*, no. 343, Aug. 31, 1902 (holotype of *Anisophyllea Cavaleriei;* photo. in A. A.).

This species is apparently closely related to *V. Dunalianum* Wight, but readily distinguished by narrow oblong-lanceolate or oblanceolate leaves 5-7 cm. long and 10-17 mm. wide, gradually narrowed into a very short petiole and acute, not acuminate, at the apex. The leaves strikingly resemble in shape and arrangement those of *V. angustilimbum* Merr. from the Philippine Islands, particularly those of Manila Bureau of Science no. 26603, except that the veins are more prominent beneath in the latter.

Vaccinium fragile Franchet in Jour. de Bot. IX. 366 (1895). — Léveillé, Cat. Pl. Yun-Nan, 94 (1916).

Pieris Gagnepainiana Léveillé in Bull. Acad. Intern. Bot. Géog. XII. 251 (1903); in Bull. Soc. Bot. France, LIII. 205 (1906); Cat. Pl. Yun-Nan, 87 (1916). — **Synon. nov.**

CHINA. Y u n n a n : environs de Yun-nan-sen, c. au pied des rochers, bord des sentiers de la montagnes, *E. Bodinier*, Dec. 3, 1896 "fleurs blanches à nervures pourpres" (holotype of *Pieris Gagnepainiana;* photo. in A. A.).

Pieris Gagnepainiana has been already identified with *V. fragile* by W. E. Evans according to a note on the type sheet. The specimen cited above represents the typical form named α. *crinita* by Franchet (l. c. 367).

Vaccinium triflorum, nom. nov.

Pieris buxifolia Léveillé & Vaniot in Bull. Soc. Bot. France, LIII. 203 (1906).

Vaccinium buxifolium Léveillé in Fedde, Rep. Spec. Nov. XII. 101 (1913); Fl. Kouy-Tchéou, 154 (1914). — Non Hooker f.

Frutex humilis, prostratus, ad 20 cm. longus, ramosus; ramuli hornotini villoso-pilosi, tarde glabrescentes, vetustiores pallide brunneo-cinerei. Folia congesta, coriacea, per plures annos persistentia, ovalia vel elliptica, rarius elliptico-obovata vel elliptico-oblonga, 1.4-2 cm. longa et 7-10 mm. lata, obtusa et leviter emarginata, basi late vel interdum angustius cuneata vel rotundata, margine integro cartilagineo recurva, supra convexa, bullato-rugosa, costa media impressa, initio sparsissime densius ad costam et basin versus pilosa, subtus costa media elevata, venis obsoletis, fuscescentia, initio ad costam sparse pilosa, demum glabra; petioli 1-2 mm. longi, initio villoso-pilosi, demum fere glabri vel glabri. Inflorescentiae axillares in ramis biennibus racemos pedunculatos abbreviatos 2-3-floros formantes; axis pedunculo incluso 2-5 mm. longa, breviter pilosula; pedicelli 3-6 mm. longi, graciles, pilosi, bracteis ovatis obtusiusculis circiter 1 mm. longis ciliatis suffulti; sepala ovata, acuminata, 1.5 mm. longa ut ovarium satis dense pilosa; corolla campanulata, 7-8 mm. longa, extus intusque glabra, alba vel flavo-alba, roseo-striata, ore vix vel non constricta, lobis late triangulari-ovatis, 2 mm. longis apice recurvis et dorso sparse pilosulis; staminą corollam subaequantia, filamentis villosis curvatis, antheris glabris tubulis apice alte fissis anthera longioribus inclusis 6 mm. longis, dorso appendiculis sursum curvatis circiter 1.5 mm. longis praeditis; stylus glaber, stamina paullo superans. Fructus non visus, ex collectore roseus, edulis.

CHINA. K w e i c h o u : Mo-chie, Tchang-t'sai, *J. Esquirol*, no. 33, May 1904, "très pauciflore; feuilles de buis ridées en dessus, rougeâtres dessous, entières au bords, rameaux et petioles velues, corolla rouge" (holotype of *Pieris buxifolia;* photo. in A. A.); Tiey-sey-kiao, 900 m., *J. Esquirol*, no. 2095, May 1910, "fl. blanche panachée de rose" (syntype of *V. buxifolium;* photo. in A. A.); Gan-chouen, rochers, AR., *J. Cavalerie*, no. 3799, May-Sept. 1910, "fl. blanc-jaune, fruit rose mangeable" (syntype of *V. buxifolium;* photo. in A. A.).

This species is similar in general appearance to *V. Delavayi* Franch., *V. dendrocharis* Hand.-Mazz., *V. conchophyllum* Rehd. and *V. moupi-*

nense Franch., but differs from all of them in the axillary 2-3-flowered inflorescence, the pubescent calyx and the open-campanulate corolla. Since Léveillé's description is very brief and insufficient, I have given above a full description based on the three specimens cited which are remarkably uniform, except that the leaves of no. 2075 are more cuneate at the base resembling those of *V. Delavayi* Franch., while the leaves of no. 3799 resemble those of *V. conchophyllum* Rehd. which may be after all only a form of *V. Delavayi.*

Vaccinium japonicum Miquel in Ann. Mus. Bot. Lugd.-Bat. I. 28 (1863); Prol. Fl. Jap. 92 (1866).

Vaccinium Fauriei Léveillé in Fedde, Rep. Spec. Nov. XII. 182 (1913). — **Synon. nov.**

KOREA. Kogen Prov.: in monte des diamantes, *U. Faurie,* no. 663, June 22, 1906 (holotype of *V. Fauriei;* photo. in A. A.).

Vaccinium japonicum var. **sinicum** (Nakai) Rehder in Jour. Arnold Arb. v. 56 (1924).

Agapetes vaccinioidea Léveillé in Bull. Acad. Intern. Géog. Bot. XII. 251 (1903); Fl. Kouy-Tchéou, 147 (1914). — **Synon. nov.**

Vaccinium siccum Léveillé & Vaniot in Fedde, Rep. Spec. Nov. IX. 447 (1911); Fl. Kouy-Tchéou, 154 (1914). — **Synon. nov.**

CHINA. Kweichou: environs de Kouy-yang, mont du Collège çà et là, *E. Bodinier,* no. 1716bis, May 26, 1898, "petit sous-arbrisseau, fl. rosées-pourprées"; mont de Lou-tsong-koan, çà et là dans la montagne, *E. Bodinier,* no. 1716, July 21, 1897, "petit arbrisseau, très cassant" (syntypes of *Agapetes vaccinioidea;* merotype in A. A.); Ma-jo, *J. Cavalerie,* no. 3010, Nov. 1907 "fruits rouges" (holotype of *V. siccum;* photo. and merotype in A. A.).

MYRSINACEAE

Determined by E. H. WALKER

Maesa tenera Mez in Engler, Pflanzenr. IV.-236, p. 28 (1902).

Maesa Martini Léveillé, in Fedde, Rep. Spec. Nov. IX. 462 (1911); Fl. Kouy-Tchéou, 286 (1914). — **Synon. nov.**

CHINA. Kweichou: bords du Hoa-kiang, *L. Martin* in hb. *Bodinier,* no. 2564, Feb. 18, 1899 (holotype of *Maesa Martini;* photo. in A. A.).

In his Flore du Kouy-Tchéou Léveillé enumerates *M. Martini* as a distinct species and on the same page as a synonym of *M. sinensis* A. DC. citing under it no. 2564 together with other numbers.

Maesa japonica (Thbg.) Moritzi apud Zollinger, Syst. Verz. Ind. Archip. III. 61 (1855). — Mez in Engler, Pflanzenr. IV.-236, p. 50, fig. 6 (1902).

Pieris oligodonta Léveillé in Bull. Soc. Bot. France, LIV. 369 (1907); Fl. Kouy-Tchéou, 150 (1914). — **Synon. nov.**

Maesa Labordei Léveillé in Fedde, Rep. Spec. Nov. IX. 462 (1911).

Maesa Esquirolii Léveillé, l. c. (1911); Fl. Kouy-Tchéou, 150 (1914). — **Synon. nov.**

Maesa Cavaleriei Léveillé, l. c. (1911); l. c. (1919). — **Synon. nov.**

Maesa Dunniana Léveillé, l. c. 463 (1911); l. c. (1914). — **Synon. nov.**

Myrsine Esquirolii Léveillé, in Fedde, Rep. Spec. Nov. XII. 186 (1913); Fl. Kouy-Tchéou, 288 (1914). — **Synon. nov.**

Vaccinium oligodontum Léveillé, Fl. Kouy-Tchéou, 150 (1914), pro synon. *Pieridis oligodontae.*

CHINA. K w e i c h o u : without precise locality, *J. Esquirol,* no. 895 (holotype of *Pieris oligodonta;* photo. in A. A.); environs de Tsingay dans la montagne à Lo-ten, *J. Laborde* in hb. *Bodinier,* no. 2513, Nov. 28, 1898 (holotype of *M. Labordei;* photo. in A. A.); Hoang-tsao-pa, *J. Esquirol,* no. 1572, June 1909 (holotype of *M. Esquirolii;* photo. in A. A.); Tou-yun, *J. Cavalerie,* Nov. 10, 1899 (holotype of *M. Cavaleriei;* merotype and photo. in A. A.); Pin-fa, bois, *J. Cavalerie,* no. 459, Apr., July, Oct. 1907 "fleurs blanches, fruit blanc et graines noires" (syntypes of *M. Dunniana;* merotype in A. A.); bois de Bangnin, *J. Esquirol,* no. 2625, March 29, 1911 (holotype of *Myrsine Esquirolii;* photo. in A. A.).

The type specimen of *Pieris oligodonta* bears on the label only the name *Vaccinium oligodontum* in Léveillé's handwriting; the species was referred to *Maesa* first by J. Hutchinson according to a label on the type sheet, but under a new unpublished combination. *Maesa Labordei* is cited in the Flore du Kouy-Tchéou as a synonym of *M. Cavaleriei.*

Ardisia tenera Mez in Engler, Pflanzenr. IV.-236, p. 104 (1902).

Ardisia Meziana Léveillé in Fedde, Rep. Spec. Nov. X. 374 (1912); Fl. Kouy-Tchéou, 283 (1914). — **Synon. nov.**

CHINA. K w e i c h o u : Lo-fou, *J. Cavalerie,* no. 3550 (errore 3530), March 1909 (holotype of *A. Meziana;* photo. in A. A.).

Ardisia brevicaulis Diels in Bot. Jahrb. XXIX. 519 (1900). — Mez in Engler, Pflanzenr. IV.-236, p. 143 (1902).

Ardisia Bodinieri Léveillé in Fedde, Rep. Spec. Nov. IX. 461 (1911); Fl. Kouy-Tchéou, 282 (1914). — **Synon. nov.**

CHINA. K w e i c h o u : district de Tsin-gay, vallée de Ly-moutchay, dans les rocailles boisées, au bord de la rivière, *E. Bodinier,* Jan. 14, 1898 (holotype of *A. Bodinieri;* merotype and photo. in A. A.).

Ardisia crispa (Thbg.) A. De Candolle in Trans. Linn. Soc. XVII. 124 (1834). — Mez in Engler, Pflanzenr. IV.-236, p. 144 (1902).

Ardisia Labordei Léveillé in Fedde, Rep. Spec. Nov. X. 373 (1912); Fl. Kouy-Tchéou (1914). — **Synon. nov.**

Ardisia crispa var. *Taquetii* Léveillé in Fedde, Rep. Spec. Nov. x. 374 (1912). — **Synon. nov.**

Bladhia crispa Thbg. var. *Taquetii* (Lévl.) Nakai, Trees Shrubs Jap. I. 208 (1922); Fl. Sylv. Kor. XIII. 16, pl. 5 (1923).

Ardisia Taquetii Léveillé in litt. ex Nakai, l. c. (1923), pro synon. var. *Taquetii*.

Bladhia lentiginosa (Ker) Nakai var. *Taquetii* Nakai, Trees Shrubs Jap. ed. 2, I. 284 (1927).

KOREA. Quelpaert: in sylvis secus torrentes, Hongno, *E. Taquet*, no. 2975, Oct. 1909 (holotype of *A. crispa* var. *Taquetii;* photo. and isotype in A. A.).

CHINA. Kweichou: district de Tsin-gay, dans les bois à Kao-tchay, *J. Laborde* in hb. *Bodinier*, no. 2512, March 8, 1898 (holotype of *A. Labordei;* photo. in A. A.).

Ardisia crispa var. *Taquetii* Lévl. can hardly be separated as a distinct variety; it is said to differ chiefly in its longer less branched stems and longer leaves.

Ardisia elegans Andrews, Bot. Rep. x. t. 623 (1811).

Ardisia elegantissima Léveillé in Fedde, Rep. Spec. Nov. x. 373 (1912). — **Synon. nov.**

CHINA. Hongkong: bois de Happy Valley, *E. Bodinier*, no. 665, June 20, 1894 "arbuste de 1-2 m., branchant seulement en haut, les branches (ci-jointes) sont alternes et se séparent de la tige principale à l'angle droit formant une tête très elegante; fleurs roses, très belles, toutes retombantes." (holotype of *A. elegantissima;* photo. in A. A.).

This species, considered by Mez as a synonym of *Ardisia crispa* may be distinguished from that species by its almost total want of punctations and by the compound and more corymbose inflorescence on longer special branches, these with scattered leaves almost throughout their length. Léveillé's *A. elegantissima* corresponds in all essentials with the typical scallop-leaved forms considered to represent Andrews' species.

Ardisia Henryi Hemsl. var. **Dielsii** (Lévl.) Walker, comb. nov.

Ardisia Dielsii Léveillé in Fedde, Rep. Spec. Nov. IX. 461 (1911); Fl. Kouy-Tchéou, 282 (1914); Cat. Pl. Yun-Nan, 177 (1916).

CHINA. Kweichou: environs de Gan-pin, grande rocaille, dans les interstices des rochers, rare, *L. Martin* in hb. *Bodinier*, no. 1636, June 10, 1897 (syntype; photo. and merotype in A. A.); environs de Kouy-yang, mont du Collège, bois rocailles, rare, *E. Bodinier*, June 1, 1898 (syntype; ex Léveillé); Pin-fa, Tou-chan, *J. Cavalerie*, June 7, 1899 (syntype; photo. in A. A.).

Ardisia Dielsii has been referred to *A. Henryi* by Handel-Mazzetti according to a note on the type sheet of no. 1636. On the label of that

specimen Martin's name does not appear, while in Léveillé's description Bodinier's name is omitted from the citation of no. 1636. On Cavalerie's specimen from Pin-fa, which undoubtedly belongs here, neither the locality Tou-chan nor the date given by Léveillé appear.

From *A. Henryi* this variety differs in the longer and more slender leaves which are narrowly long-lanceolate, 12-20 cm. long and 1-4 cm. wide, the lateral nerves very clearly curved-ascending.

Ardisia Faberi Hemsley in Jour. Linn. Soc. Bot. XXVI. 64 (1889). — Mez in Engler, Pflanzenr. IV.-236, p. 153 (1902).

Ardisia castaneifolia Léveillé in Fedde, Rep. Spec. Nov. IX. 461 (1911). — Non Mez.

Ardisia Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. X. 374 (1912); Fl. Kouy-Tchéou, 282 (1914); Cat. Pl. Yun-Nan, 177 (1916). — **Synon. nov.**

CHINA. K w e i c h o u : environs de Tou-chan, *J. Cavalerie* in hb. *Bodinier,* June 1899 (syntype of *A. castaneifolia;* photo. in A. A.); Pin-fa, chutes d'eau, *J. Cavalerie,* no. 751, Dec. 9, 1910 (syntype of *A. castaneifolia;* ex Léveillé); Pin-fa, *J. Esquirol,* June 15, 1905 "fleurs roses, fruits d'un rouge clair" (syntype of *A. Cavaleriei;* photo. in A. A.).

Since *Ardisia castaneifolia* Lévl. is invalidated by the earlier homonyms *A. castaneifolia* Mez, Léveillé changed the name to *A. Cavaleriei,* citing an additional specimen under that name.

Embelia oblongifolia Hemsley in Jour. Linn. Soc. XXVI. 62 (1889). — Mez in Engler, Pflanzenr. IV.-236, p. 316 (1902).

Embelia Bodinieri Léveillé in Fedde, Rep. Spec. Nov. IX. 327 (1911); Fl. Kouy-Tchéou, 284 (1914). — **Synon. nov.**

CHINA. K w e i c h o u : without precise locality, *J. Esquirol,* no. 743 (holotype of *E. Bodinieri;* photo. in A. A.), no. 726 (cited in Fl. Kouy-Tchéou; duplicate in A. A.).

Embelia pauciflora Diels in Bot. Jahrb. XXIX. 517 (1900). — Mez in Engler, Pflanzenr. IV.-236, p. 325 (1902).

Embelia Schlechteri Léveillé in Fedde, Rep. Spec. Nov. X. 374 (1912); Fl. Kouy-Tchéou, 285 (1914). — **Synon. nov.**

CHINA. K w e i c h o u : environs de Kouy-yang, mont du Collège, à l'entrée d'une grotte, *E. Bodinier,* no. 2049, Feb. 1898 "petit arbuste" (holotype of *E. Schlechteri;* merotype in A. A.).

Of the type of *Embelia pauciflora* only a photograph has been seen which, however, so closely corresponds in all observable characters with the type of *E. Schlechteri,* that this reduction can safely be made. Also the proximity of the type localities lends support to their identity.

Embelia pauciflora var. **Blinii** (Lévl.) Walker, comb. nov.

Embelia Blinii Léveillé in Fedde, Rep. Spec. Nov. x. 375 (1912); Fl. Kouy-Tchéou, 284 (1914).

Embelia Dielsii Léveillé, l. c. 374 (1912); Fl. Kouy-Tchéou, 284 (1914). — **Synon. nov.**

Embelia Kaopoensis Léveillé in Fedde, Rep. Spec. Nov. xii. 186 (1913).

China. Kweichou: Kouy-yang, mont du Collège, à Ke-matong, *J. Chaffanjon* in hb. *Bodinier*, no. 2081, Feb. 1898 "liane de 2-3 m." (holotype of *E. Blinii;* merotype in A. A.); Pin-fa, bois, *J. Cavalerie*, no. 1327, Feb. 17, 1903 (holotype of *E. Dielsii;* photo. in A. A.); Kao-po, *E. Bodinier*, Dec. 15 (holotype of *E. Kaopoensis;* photo. in A. A.).

The variety corresponds, so far as available material reveals, in all respects with the species except in the leaf-shape which in the variety is narrowly oblong-lanceolate rather than ovate-lanceolate to ovate as in the species.

Embelia Kaopoensis was referred as a synonym to *E. Dielsii* by Léveillé in his Flore du Kouy-Tchéou.

Myrsine semiserrata Wallich in Roxburgh, Fl. Ind. ii. 293 (1824); Mez in Engler, Pflanzenr. iv.-339 (1902). — Léveillé, Fl. Kouy-Tchéou, 288 (1914).

Celastrus Cavalerici Léveillé in Fedde, Rep. Spec. Nov. xiii. 262 (1914). — **Synon. nov.**

Celastrus Seguini Léveillé, l. c. (1914).

China. Kweichou: Pin-fa, bois, rare, *J. Cavalerie*, no. 1744, Apr. 5, 1904 (holotype of *Celastrus Cavaleriei;* photo. in A. A.); environs de Hoang-ko-chou, rocailles de la cascade, *J. Seguin* in hb. *Bodinier*, no. 2609, March 15, 1899 "arbrisseau, plante femelle" (syntype of *Celastrus Seguini;* photo. in A. A.); environs de Kouy-yang, mont du Collège, sous les rochers de la cascade, *E. Bodinier*, no. 2180, March 30, 1898 "grand arbuste, plante femelle" (syntype of *C. Seguini;* photo. in A. A.).

Celastrus Seguini is cited by Léveillé in his Flore du Kouy-Tchéou (l. c.) as a synonym of *Myrsine semiserrata*, but Seguin, no. 2609, is not cited and Bodinier's no. 2180 is cited as no. 2181. *Celastrus Cavaleriei* is not cited as a synonym, but the type of this species, Cavalerie no. 1744, is enumerated under *Myrsine semiserrata* together with other Cavalerie numbers. *Celastrus Cavaleriei* Lévl. of 1914 cited above should not be confused with *C. Cavaleriei* Lévl. of 1916 (Monde des Pl. ser. 2, xviii. 31) which is *C. stylosa* Wall. (Jour. Arnold Arb. xiv. 250).

Myrsine africana Linnaeus, Spec. Pl. 196 (1753). — Mez in Engler, Pflanzenr. IV.-236, p. 340, fig. 58 (1902).

Rhamnus myrtillus Léveillé in Fedde, Rep. Spec. Nov. XII. 535 (1913); Fl. Kouy-Tchéou, 343 (1915); Cat. Pl. Yun-Nan, 228 (1917). — **Synon. nov.**

CHINA. K w e i c h o u : Pin-fa, *J. Cavalerie,* no. 840, March 9, 1902 "fl. rouges" (cited in Fl. Kouy-Tchéou under *Rhamnus myrtillus;* duplicate in A. A.). Y u n n a n : collines de Tong-tchouan, sous bois, alt. 2550 m., *E. E. Maire,* in 1912 "arbrisseau buissonant toujours vert, haut 0.30 m., fl. vertes, fruit noir" (holotype of *Rhamnus myrtillus;* merotype in A. A.).

Rapanea neriifolia (S. & Z.) Mez in Engler, Pflanzenr. IV.-236, p. 361 (1902).

Myrsine Seguini Léveillé, Fl. Kouy-Tchéou, 228 (1914). — **Synon. nov.**

CHINA. K w e i c h o u : environs de Ou-la-gay, pref. de Chen-lin, dans les rocailles, *J. Seguin* in hb. *Bodinier,* no. 2253, Apr. 10, 1898, "grand arbuste" (holotype of *Myrsine Seguini;* merotype in A. A.).

PRIMULACEAE

Determined by H. HANDEL-MAZZETTI[1]

Lysimachia Navillei (Lévl.) Handel-Mazzetti, comb. nov.

Diospyros Navillei Léveillé, Fl. Kouy-Tchéou, 145 (1914).

Lysimachia solanoides Handel-Mazzetti in Not. Bot. Gard. Edinb. XVI. 70 (1928).

CHINA. K w e i c h o u : Tchei-tchou, *J. Esquirol,* no. 749, Aug. 1905, "fl. blanche" (holotype of *Diospyros Navillei;* photo. in A. A.; a duplicate of this number is a syntype of *L. solanoides*).

There are apparently two specimens of Esquirol's no. 749 in the Herbarium Léveillé; one is cited under *Diospyros Navillei* with the locality given as "Tchei-tchou" and one under *Lysimachia foenum-graecum* (Fl. du Kouy-Tchéou, 324. 1915) with the locality "Tche-tchou." The latter is one of the two specimens on which Handel-Mazzetti based his *L. solanoides.* By Léveillé the specimen of *D. Navillei* is cited as no. 249, by Handel-Mazzetti as no. 749. The latter is correct; the first figure of the number on the label in the Herb. Léveillé is partly cut off, so that it looks like "2," but the correct number 749 in blue pencil is found on the same label.

[1]Only those species of *Lysimachia* are enumerated here which had been referred by Léveillé to ligneous genera.

Lysimachia lancifolia Craib in Kew Bull. Misc. Inform. 1918, p. 363. — Handel-Mazzetti in Not. Bot. Gard. Edinb. XVI. 72 (1928).

Ardisia Esquirolii Léveillé in Fedde, Rep. Spec. Nov. XII. 186 (1913); Fl. Kouy-Tchéou, 283 (1914); non *Lysimachia Esquirolii* Bonati (1913). — **Synon. nov.**

CHINA. K w e i c h o u : chute d'eau de Hoang-tsao-pa, *J. Esquirol*, no. 1546, June 1909 "fleurs jaunes" (holotype of *Ardisia Esquirolii;* photo. and merotype in A. A.).

Lysimachia capillipes Hemsl. var. **Cavaleriei** (Lévl.) Handel-Mazzetti, comb. nov.

Andrachne Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. XII. 187 (1913); Fl. Kouy-Tchéou, 158 (1914).

CHINA. K w e i c h o u : Ta-ting, grotte no. 2, alt. 630 m., *J. Esquirol*, no. 2238, Sept. 1910 (holotype of *Andrachne Cavaleriei;* photo. in A. A.).

SAPOTACEAE

Sideroxylon Wightianum Hooker & Arnott, Bot. Beechey Voy. 196, t. 41 (1841).

Rhamnus coriaceifolius Léveillé in Fedde, Rep. Spec. Nov. XII. 535 (1913); Fl. Kouy-Tchéou, 342 (1915). — **Synon. nov.**

CHINA. K w e i c h o u : Chouang-chan-po, *J. Esquirol*, no. 3142, May 1911 (holotype of *Rhamnus coriaceifolius;* photo. and merotype in A. A.).

Sideroxylon Wightianum has apparently not been reported as yet from western and central China.

EBENACEAE

Diospyros mollifolia Rehder & Wilson in Sargent, Pl. Wilson. II. 591 (March 30, 1916). — Léveillé, Cat. Pl. Yun-Nan, 83 (1916).

Diospyros Mairei Léveillé, Cat. Pl. Yun-Nan, 83 (May 5, 1916). — **Synon. nov.**

CHINA. Y u n n a n : collines arides rocheuses derrière Lo-kou, 2450 m., *E. E. Maire*, May 1912 "grand arbuste, très rameux; fl. jaune-verdâtres" (holotype of *D. Mairei;* merotype in A. A.).

Diospyros Esquirolii Léveillé, Fl. Kouy-Tchéou, 145 (1914).

CHINA. K w e i c h o u : ramparts de Kouy-yang-fou, *J. Esquirol*, no. 449, May 1905 "arbre 12 à 14 m." (holotype; merotype and photo. in A. A.).

According to a note on the type sheet Handel-Mazzetti considers this a good species related to *D. dumetorum* W. W. Sm.

Diospyros kaki L. f. var. **silvestris** Makino in Tokyo Bot. Mag. XXII. 159 (1908).

Diospyros Argyi Léveillé in Mem. Acad. Ci. Art. Barcelona, ser. 3, XII. 550 (Cat. Pl. Kiang-Sou, 10) (1916). — **Synon. nov.**

CHINA. K i a n g s u : Sou-tchéou-fou; Ve-ven; Tchong-tchéou-fu, Ven-sie, iles du Se-men, Ta-hou, *Ch. d'Argy* [1861-74] (holotype of *D. Argyi;* photo. in A. A.).

Though six localities are numerated on the folder of the specimen and cited by Léveillé, there is only one specimen with fragments of ripe fruits in the Herbarium Léveillé. According to a note on the type sheet this specimen was identified by Handel-Mazzetti as *D. kaki* var. *silvestris*.

STYRACACEAE

Pterostyrax Leveillei (Fedde) Chun in Hooker's Icon. Pl. XXXII. t. 3161 (1932).

Styrax Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. IX. 447 (1911). — Non Léveillé (1907).

Styrax Leveillei Fedde apud Léveillé, Fl. Kouy-Tchéou, 407 (1915).

Pterostyrax Cavaleriei (Lévl.) Guillaumin in Bull. Soc. Bot. France, LXX. 886 (1924).

CHINA. K w e i c h o u : route de Pin-fa à Tou-yun, rare, *J. Cavalerie,* no. 2992, May 1905, "fleur blanc-cendre" (holotype of *Styrax Cavaleriei* of 1911 and of *S. Leveillei;* photo. in A. A.).

This species, easily distinguished from the other species of the genus by its tricuspidate leaves, has also been found in Kwangsi near the Kweichou border (R. C. Ching, no. 2962).

Styrax Argyi Léveillé in Fedde, Rep. Spec. Nov. XI. 64 (1912); Fl. Kouy-Tchéou, 407 (1915).

Styrax iopilina Diels in Notizbl. Bot. Gart. Mus. Berlin, IX. 1028 (1926). — **Synon. nov.**

CHINA. K i a n g s u : without precise locality, *Ch. d'Argy,* (1861-74) (holotype; merotype in A. A.).

I have little doubt that *S. iopilina* Diels which is represented in this herbarium by an isotype and photograph of the type, is referable as a synonym to *S. Argyi.* Since the latter is known only with flower buds and the former with fruits, the comparison has to depend on vegetative characters and the inflorescence, in which I can find no difference.

Styrax japonicus Siebold & Zuccarini, Fl. Jap. I. 53, t. 23 (1835). — Perkins in Engler, Pflanzenr. IV.-241 (Heft 30), 73 (1907).

Styrax Bodinieri Léveillé in Fedde, Rep. Spec. Nov. IV. 332 (1907); Fl. Kouy-Tchéou, 407 (1915). — **Synon. nov.**

CHINA. K w e i c h o u : environs de Kouy-yang, mont du Collège, *E. Bodinier,* no. 2221, Apr. 1898 "grand arbuste a fleurs blanches odorantes" (holotype of *S. Bodinieri;* photo. in A. A.).

Styrax Bodinieri was first identified with *S. japonicus* by W. W. Smith according to a note on the type sheet.

Styrax grandiflorus Griffith, Notul. Pl. As. IV. 287 (1854). — Perkins in Engler, Pflanzenr. IV.-241 (Heft 30), 75 (1907).

Styrax Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. IV. 331 (1907); Fl. Kouy-Tchéou, 407 (1915). — **Synon. nov.**

Styrax touchanensis Léveillé in Fedde, Rep. Spec. Nov. XI. 64 (1912); Fl. Kouy-Tchéou, 407 (1915). — **Synon. nov.**

CHINA. K w e i c h o u : Long-ly, *J. Cavalerie,* no. 997, May 7, 1903, "fleurs blanches" (holotype of *S. Cavaleriei;* merotype in A. A.); Tou-chan, *E. Bodinier,* April 1902 (holotype of *S. touchanensis;* merotype in A. A.).

Styrax touchanensis and *S. Cavaleriei* have been determined by W. W. Smith as *S. grandiflorus* according to notes on the type sheet; the second species as *S. grandiflorus* forma.

SYMPLOCACEAE

Symplocos setchuensis Brand in Bot. Jahrb. XXIX. 528 (1900); in Engler, Pflanzenr. IV.-242 (Heft 6), 31 (1901).

Symplocos Argyi Léveillé in Fedde, Rep. Spec. Nov. X. 431 (1912); in Mem. Acad. Ci. Art. Barcelona, ser. 3, XII. 562 (Cat. Pl. Kiang-Sou, 22) (1916). — **Synon. nov.**

CHINA. K i a n g s u : Y-hien-hien, Long-ze près Tsang-fou, *Ch. d'Argy* (1861-74) (holotype of *S. Argyi;* merotype in A. A.).

Symplocos coronigera Léveillé in Fedde, Rep. Spec. Nov. X. 431 (1912); Fl. Kouy-Tchéou, 409 (1915).

Symplocos Wilsonii Brand in Fedde, Rep. Spec. Nov. III. 216 (Dec. 31, 1906); non Hemsley (July 1906). — **Synon. nov.**

Symplocos xanthoxantha in Bull. Géog. Bot. XXIV. 283 (1914); Cat. Pl. Yun-Nan, 268 (1917). — **Synon. nov.**

CHINA. W e s t e r n H u p e h : north and south of Ichang, *E. H. Wilson,* Veitch Exp. no. 58, April, Sept. 1900 (syntypes of *S. Wilsonii;* isotypes in A. A.). E a s t e r n S z e c h u a n : Tchen-kéou-tin, *P. Farges,* no. 796 (syntype of *S. Wilsonii;* isotype in A. A.). K w e i c h o u : Ma-jo, *J. Cavalerie,* no. 3106, July 24, 1897 (holotype of *S. coronigera;* merotype in A. A.). Y u n n a n : sous bois de montagnes de Mo-tsou, alt. 3000 m., *E. E. Maire,* April 1913 (holotype of *S. xanthoxantha;* photo. in A. A.).

Symplocos xanthoxantha was first identified with *S. Wilsonii* Brand

by A. Guillaumin according to a note on the type specimen dated 22, III. 1924, but *S. Wilsonii* Brand is invalidated by the earlier homonym *S. Wilsonii* Hemsl. which is identical with *S. stellaris* Brand. *Symplocos coronigera* is closely related to *S. setchuensis,* from which it chiefly differs in the bracts and sepals being glabrous on the back, also in the usually oblong fruit 8-12 mm. long (ovoid and about 6-7 mm. long in *S. setchuensis*), in the generally longer petioles and in the usually somewhat larger inflorescence often with a distinct axis which in fruit may be 5-10 mm. long. The species has been often confused with *S. setchuensis,* of which it may be only a variety; most western specimens usually referred to *S. setchuensis* belong to *S. coronigera,* as do all the specimens from Yunnan I have seen, additional specimens from Kweichou (W. Y. Chun, no. 7746, and A. N. Steward, Chias & Cheo, no. 486) and most of the specimens from Szechuan. In the eastern provinces *S. coronigera* does apparently not occur and all the material before me from Chekiang and Kiangsi is *S. setchuensis.*

Symplocos paniculata (Thbg.) Miquel in Ann. Mus. Bot. Lugd.-Bat. III. 102 (1867); Prol. Fl. Jap. 266 (1867).

Symplocos crataegoides Hamilton apud D. Don, Prodr. Fl. Nepal. 145 (1825). — Léveillé, Fl. Kouy-Tchéou, 409 (1914); Cat. Pl. Yun-Nan, 268 (1917). — Brand in Engler, Pflanzenr. IV.-242 (Heft 6), 33 (1901).

Symplocos paniculata Wallich ex Don, Fl. Nepal. 145 (1825), pro synon. *S. crataegoidis.* — Wallich, Num. List, no. 4429 (1832), nom. nud.

Cotoneaster coreanus Léveillé in Fedde, Rep. Spec. Nov. XI. 64 (1912). — **Synon. nov.**

Prunus Mairei Léveillé in Bull. Géog. Bot. XXV. 45 (1915); Cat. Pl. Yun-Nan, 233 (1917). — **Synon. nov.**

Crataegus Lyi Léveillé, Fl. Kouy-Tchéou, 346 (1915). — **Synon. nov.**

Prunus Lyi Blin ex Léveillé, l. c. (1915), pro synon. *Crataegi Lyi.*

KOREA. Quelpaert: in sylvis Hallaisan, 1400 m., *E. Taquet,* no. 1106, Sept. 7, 1908 (holotype of *Cotoneaster coreanus;* merotype and isotype in A. A.).

CHINA. Kweichou: route de Gan-pin à Kouy-yang, *J. Cavalerie,* no. 2098, pro parte (fr.) (holotype of *Crataegus Lyi;* photo. in A. A.). Yunnan: flanc de montagne à Pé-long-tsin, 3200 m., *E. E. Maire,* May (1912?), "arbre-moyen, fl. blanches" (syntype of *Prunus Mairei;* merotype in A. A.); rochers du plateau de Sin-tang, 2800 m. *E. E. Maire,* May 1912 (syntype of *P. Mairei,* ex Léveillé).

Symplocos paniculata biloba f. (Lévl.), stat. nov.

Crataegus biloba Léveillé, Fl. Kouy-Tchéou, 346 (1915).

CHINA. K w e i c h o u : route de Gan-pin à Kouy-yang, *J. Cavalerie,* no. 2098, pro parte (fl.) (holotype of *Crataegus biloba;* photo. in A. A.).

This is an interesting variation with all the leaves distinctly obcordate and deeply emarginate at the apex. The leaf of *S. paniculata* is normally elliptic or oval to oblong and acute or acuminate at the apex, but sometimes at least part of the leaves are rounded at the apex and occasionally slightly emarginate as in Henry no. 9948, Rock no. 3160, and Schoch no. 50 from Yunnan and H. H. Hu 1598 from Chekiang.

Symplocos fasciculata Zoll. var. **chinensis** Brand in Fedde, Rep. Spec. Nov. III. 217 (1906).

Symplocos Stapfiana Léveillé in Fedde, Rep. Spec. Nov. IX. 444 (1911); Fl. Kouy-Tchéou, 410 (1915). — **Synon. nov.**

CHINA. K w e i c h o u : Kai-tchéou, Ma-jo, *J. Cavalerie,* no. 3287, June-Aug. 1908, "arbre à fleurs blanches, fruits noirs" (holotype of *S. Stapfiana;* photo. in A. A.).

Symplocos Stapfiana has been identified by A. Guillaumin as *S. fasciculata* var. *chinensis* according to a note on the type sheet. I have not seen the type of Brand's variety which is described as having 30-40-flowered fascicles; Cavalerie's plant has the flowers in 5-7-flowered solitary racemes only occasionally with 1 to 2 branches at the base. Léveillé describes the fruit but I have seen only a flowering specimen.

Symplocos pinfaensis Léveillé in Fedde, Rep. Spec. Nov. IX. 77 (1910).

Symplocos spicata Léveillé, Fl. Kouy-Tchéou, 410 (1915), pro parte, quoad Cavalerie 838; vix Roxburgh.

CHINA. K w e i c h o u : Pin-fa, *J. Cavalerie,* no. 838, March 18, 1902, "fl. blanches odorantes" (holotype; photo. in A. A.).

This species resembles very much *S. terminalis* Brand, but the two inflorescences present are simple short racemes, the flowers have fewer stamens, about 20, and the leaves are chartaceous with the veins above slightly raised, not impressed as in *S. terminalis.* It also resembles the following species, but differs in the short racemes, fewer stamens and in the smaller and comparatively broader leaves. It may also be compared with *S. lancifolia* S. & Z. and *S. caudata* Wall. which both have simple racemes, but smaller flowers partly stalked in the latter.

Symplocos laurina (Retz.) Wallich, Num. List, no. 4416 (1832). — Rehder & Wilson in Sargent, Pl. Wilson. II. 594 (1916).

Symplocos spicata Roxburgh, Cat. Hort. Beng. 40 (1814), nom. nud.; Fl. Ind. ed. 2, II. 541 (1832). — Léveillé, Fl. Kouy-Tchéou, 410 (1915), excl. no. 838; Cat. Pl. Yun-Nan, 268 (1917).

Eurya Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. IX. 450 (1911).
Maesa Bodinieri Léveillé & Blin in Léveillé, Fl. Kouy-Tchéou, 286 (1914). — **Synon. nov.**
Symplocos vinoso-dentata Léveillé in Bull. Géog. Bot. XXIV. 283 (1914); Fl. Kouy-Tchéou, 410 (1915). — **Synon. nov.**

China. Kweichou: Pin-fa, Juin-ou-chan, *J. Cavalerie,* no. 406, Sept. 8, 1902 (holotype of *Eurya Cavaleriei* and *Maesa Bodinieri;* photo. in A. A.). Yunnan: colline de Long-ky, 500 m., *E. E. Maire,* June 1913, "gros arbre à feuilles persistantes, fl. jaunâtre" (holotype of *S. vinoso-dentata;* merotype in A. A.).

In his Flore du Kouy-Tchéou (l. c.) Léveillé transferred *Eurya Cavaleriei* to *Maesa* as *M. Bodinieri.* In Cavalerie no. 406 the leaves are only sparingly denticulate above the middle, while in Maire's specimen they are serrate except near the base; in both specimens they are oblong to oblong-lanceolate and about 15 cm. long. Both specimens are referable to var. *acuminata* (Bl.) Brand which, however, hardly differs enough to be maintained as a distinct variety.

Symplocos lancifolia Siebold & Zuccarini in Abh. Akad. Muench. IV. pt. 3, p. 133 (Fl. Jap. Fam. Nat. II. 9) (1846). — Brand in Engler, Pflanzenr. IV.-242, p. 41 (1901).

Symplocos aurea Léveillé in Fedde, Rep. Spec. Nov. IX. 445 (1911); Fl. Kouy-Tchéou, 409 (1915). — **Synon. nov.**

China. Kweichou: Pin-fa, hautes montagnes, *J. Cavalerie,* no. 2312, April 26, 1906 "arbre 2 m., fleurs blanches, legèrement odorantes" (holotype of *S. aurea;* merotype in A. A.).

Symplocos Bodinieri Brand in Fedde, Rep. Spec. Nov. III. 217 (1906).

Symplocos Balfourii Léveillé in Fedde, Rep. Spec. Nov. IX. 77 (1910); Fl. Kouy-Tchéou, 409 (1915). — **Synon. nov.**
Maesa aurea Léveillé in Fedde, Rep. Spec. Nov. X. 375 (1912); Fl. Kouy-Tchéou, 286 (1914). — **Synon. nov.**

China. Kweichou: Pin-fa, bois, *J. Cavalerie,* no. 2527, Oct. 11, 1905, "arbuste, fl. blanches" (holotype of *S. Balfourii;* photo. in A. A.); environs de Tou-chan, *J. Cavalerie,* no. 2719, Oct. 1, 1899 "arbuste" (holotype of *Maesa aurea;* photo. in A. A.; a duplicate in hb. Paris being the holotype of *S. Bodinieri* Brand).

Symplocos Balfourii has been identified in 1924 by Guillaumin as *S. Bodinieri* according to a note on the type sheet. Cavalerie 2719 in herb. Léveillé is the type of *Maesa aurea* and another specimen of Cavalerie 2719 in herb. Paris is the type of *S. Bodinieri* Brand, though by Brand the number is cited as 2179, which apparently is a misprint for 2719.

Symplocos botryantha Franchet in Nouv. Arch. Mus. Paris, sér. 2, x. 60 (Pl. David. II. 98) (1888). — Brand in Engler, Pflanzenr. IV.-242, p. 60 (1901).

Symplocos caerulea Léveillé in Fedde, Rep. Spec. Nov. IX. 77 (1910); Fl. Kouy-Tchéou, 409 (1915). — **Synon. nov.**

CHINA. Kweichou: Pin-fa, *J. Cavalerie,* nos. 2293, 2403, April 13 and June 5, "petit arbre, fl. blanches et bleu d'azur" (syntypes of *S. caerulea;* merotype (June 5) and photo. (Apr. 13) in A. A.).

Symplocos Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. IX. 77 (1910); Fl. Kouy-Tchéou, 409 (1915).

CHINA. Kweichou: Pin-fa, Niang-ouang, *J. Cavalerie,* no. 1022, May 28, 1903, "arbrisseau" (holotype; photo. in A. A.).

This species seems to be related to *S. botryantha,* but is easily distinguished by the small obovate-oblong, closely crenate-serrulate leaves rather abruptly contracted into a short obtuse acumen, and by the small fruit in short racemes.

Symplocos Martini Léveillé in Fedde, Rep. Spec. Nov. IX. 77 (1910); Fl. Kouy-Tchéou, 410 (1915).

CHINA. Kweichou: Kouy-yang, mont du Collège, *E. Bodinier,* April 1898 (holotype; photo. in A. A.).

This is very similar to *S. botryantha* Franch., but the leaves are broader, generally elliptic and the calyx-tube is silky-strigose.

Symplocos punctata Brand in Fedde, Rep. Spec. Nov. III. 217 (1906).

Symplocos Bodinieri Léveillé in Fedde, Rep. Spec. Nov. IX. 76 (1910); non Brand.

Symplocos splendens Léveillé in Fedde, Rep. Spec. Nov. XII. 186 (1913); Fl. Kouy-Tchéou, 410 (1915); Cat. Ill. Pl. Seu-Tchouen, pl. 62 (1918) MS. — **Synon. nov.**

CHINA. Kweichou: environs de Kouy-yang, dans les bois de la pagode de Kien-lin-chan, rare, *E. Bodinier,* no. 2224, April 14, 1898, "arbre de moyenne hauteur à belles fleurs bleues d'une odeur delicieuse" (holotype of *S. Bodinieri* and *S. splendens;* photo. in A. A.; an isotype in herb. Paris being the holotype of *S. punctata* Brand).

Symplocos punctata Brand and *S. Bodinieri* Lévl. are both based on Bodinier's no. 2224, the former on a specimen in the Paris herbarium, the latter on one in the herbarium Léveillé. The name *S. Bodinieri* was changed later by Léveillé to *S. splendens* on account of the earlier *S. Bodinieri* Brand.

Symplocos anomala Brand in Bot. Jahrb. XXIX. 67 (1900); in Engler, Pflanzenr. IV.-242, p. 67 (1901).

Symplocos Dielsii Léveillé in Fedde, Rep. Spec. Nov. IX. 445 (1911); Fl. Kouy-Tchéou, 409 (1915). — **Synon. nov.**

Symplocos Esquirolii Léveillé, l. c. (1911); l. c. (1915). — **Synon. nov.**

China. Kweichou: route Pin-fa à Long-ly, bois, *J. Cavalerie,* no. 3330, Aug. 10, 1908 (holotype of *S. Dielsii;* photo. in A. A.); Pin-fa, Ma-jo, *J. Cavalerie,* no. 2380, June 1908, "arbrisseau" (holotype of *S. Esquirolii;* merotype in A. A.).

Symplocos Dielsii has been identified by A. Guillaumin with *S. anomala* according to a note on the type sheet. *Symplocos Esquirolii* I refer to the same species, though the fruits are up to 1 cm. long, but the leaves agree exactly with those of *S. anomala.*

Symplocos adenopus Hance in Jour. Bot. XXI. 322 (1883). — Brand in Engler, Pflanzenr. IV.-242, p. 67 (1901).

Symplocos Prainii Léveillé in Fedde, Rep. Spec. Nov. IX. 445 (1911); Fl. Kouy-Tchéou, 410 (1915). — **Synon. nov.**

China. Kweichou: route de Pin-fa à Tou-yun, bois, rare, *J. Cavalerie,* no. 2966, Aug. 2, 1908, "arbre, fl. blanc-rosée" (holotype of *S. Prainii;* photo. and merotype in A. A.).

Cavalerie no. 2966 differs slightly from the type of *S. adenopus* in its leaves having a tendency toward an oblong-ovate shape being mostly broadest below the middle, while in the type specimen the leaves are slightly broader above the middle.

Symplocos stellaris Brand in Bot. Jahrb. XXIX. 528 (1900); in Engler, Pflanzenr. IV.-242, p. 68 (1901).

Symplocos Dunniana Léveillé in Fedde, Rep. Spec. Nov. IX. 445 (1911); Fl. Kouy-Tchéou, 409 (1915). — **Synon. nov.**

Litsea Chaffanjonii Léveillé in Fedde, Rep. Spec. Nov. XII. 182 (1913); Fl. Kouy-Tchéou 220 (1914). — **Synon. nov.**

Symplocos neriifolia Guillaumin in Lecomte, Fl. Gén. Indochine, III. 1011 (1933), quoad syn. *S. Dunnianus.* — Non Sieb. & Zucc.

China. Kweichou: route de Pin-fa à Tou-yun, bois, *J. Cavalerie,* no. 3016, May 10, 1908, "arbre, fl. blanc-rose, odor." (holotype of *S. Dunniana;* photo. in A. A.); environs de Kouy-yang, mont du Collège, *J. Chaffanjon,* no. 2244, April 15, 1898, "arbre" (holotype of *Litsea Chaffanjonii;* photo. in A. A.).

Symplocos Mairei Léveillé in Monde Pl. ser. 2, XVIII. 28 (1916), Cat. Pl. Yun-Nan, 268 (1917).

China. Yunnan: brousse des collines à Long-ky, 500 m., *E. E. Maire,* June 1912 "petit arbre à feuilles persistentes, fl. jaunes" (holotype; merotype in A. A.).

This species is very similar to the preceding species, but the margin of

the leaves is rather closely and finely denticulate nearly to the base with 3-4 teeth to 1 cm. almost reduced to a gland-like conical mucro, and the lateral veins and transverse veinlets are prominent beneath and impressed above; the not fully open closely fascicled flowers are smaller, with broader and shorter petals and quite glabrous, not ciliate, calyx-lobes. I have not been able to identify it with any described species.

In the Herb. Léveillé there is another specimen from the same locality named in Léveillé's handwriting "*Symplocos Mairei* Lévl." which represents an entirely different species. It is very similar and apparently referable to *S. myriantha* Rehd. from Szechuan, but the inflorescences are much less branched and in several instances consist of simple short racemes, but some have at the base small branches with a few crowded flowers. Shape and venation of the leaves are exactly the same and so is the pubescence of the inflorescence and the color of the branches. The flowers of Maire's specimen, however, seem to be somewhat larger, but they are almost all fully open, while those of the type of *S. myriantha* are still in bud.

OLEACEAE

Fontanesia Fortunei Carrière in Rev. Hort. 1859, p. 43. — Schneider, Ill. Handb. Laubholzk. II. 809, fig. 511a-d (1911).

Fontanesia Argyi Léveillé in Mem. Acad. Ci. Art. Barcelona, ser. 3, XII. 557 (Cat. Pl. Kiang-Sou, 17) (1916). — **Synon. nov.**

CHINA. K i a n g s u : Siao-tse-jang, *Ch. d'Argy* [1861-74], "sepes vivas et densas constituit" (holotype of *F. Argyi;* merotype in A. A.).

Fraxinus Griffithii C. B. Clarke in Hooker f., Fl. Brit. Ind. III. 605 (1882). — Lingelsheim in Engler, Pflanzenr. IV.-243[I-II], p. 15 (1920).

Ligustrum Vanioti Léveillé, Cat. Pl. Yun-Nan, 181 (1916). — **Synon. nov.**

CHINA. Y u n n a n : rochers de Ma-hong, 3000 m., *E. E. Maire,* June 1912, "petit arbre, feuilles caduques, fl. blanches" (holotype of *Ligustrum Vanioti;* photo. in A. A.).

Léveillé apparently mistook the pinnate leaves for slender branchlets with simple leaves and did not examine the flowers closely.[1]

Syringa Mairei (Lévl.), comb. nov.

Ligustrum Mairei Léveillé, Cat. Yun-Nan, 181 (1916).

Syringa rugulosa McKelvey in Jour. Arnold Arb. VI. 153 (1925); Lilacs, 148 (1928). — **Synon. nov.**

[1]Under the genus *Fraxinus* Léveillé described only one new species, *Fraxinus Fauriei* (Fedde, Rep. Spec. Nov. VIII. 285, 1910) from Quelpaert, based on Faurie no. 1867; this turns out to be *Meliosma Oldhamii* Miq. and has been already referred to that species by Nakai in 1918 (Tokyo Bot. Mag. XXXII. 119. 1918).

China. Yunnan: brousse des montagnes à Tcha-ho, 2600 m., *E. E. Maire,* July (1910-13), "arbuste buissonant, haut 1.80 m.; fl. rose violacé" (holotype of *Ligustrum Mairei* in Herb. Léveillé and holotype of *Syringa rugulosa* in Herb. Edinb.; photos. of both in A. A.); brousse des montagnes a Pe-long-tsin, 3000 m., *E. E. Maire,* June [1910-13], "petit arbre buissonant, peu rameaux, fl. blanches, en grappes dressées" (paratype of *S. rugulosa;* in Herb. A. A.).

Ligustrum Mairei and *Syringa rugulosa* are based on two specimens of the same collection. The identity of both has been first established in the herbarium at Edinburgh according to a note on the cover of the specimen.

Syringa Fauriei Léveillé in Fedde, Rep. Spec. Nov. VIII. 285 (1910). — Nakai in Jour. Coll. Sci. Univ. Tokyo, XXXI. Add. 509 (Fl. Kor. pt. II.) (1911); Fl. Sylv. Kor. x. 46 (1921). — McKelvey, Lilacs, 507 (1928).

Korea. Kōgen Prov.: in monte des diamants, *U. Faurie,* no. 714, June 21, and no. 722, May 22, 1906 (syntypes; isotypes in A. A.).

This is closely related to *S. amurensis* Rupr., but readily distinguished by the lanceolate or oblong-lanceolate leaves short-pilose beneath along the midrib and the lower part of the lateral veins.

Osmanthus Delavayi Franchet in Bull. Soc. Linn. Paris, I. 613 (1886). — Léveillé in Cat. Pl. Yun-Nan, 181 (1916).

Ligustrum phillyrea Léveillé in Bull. Géog. Bot. XXV. 41 (1915); Cat. Pl. Yun-Nan, 181 (1916). — **Synon. nov.**

China. Yunnan: rochers moussus de Io-chan, 3200 m., *E. E. Maire,* May 1912, "sous-arbrisseau toujours vert, haut 0.20 m., fl. blanches" (syntype of *Ligustrum phillyrea;* photo. in A. A.); brousse de montagnes à Pe-long-tsin, 3200 m., *E. E. Maire,* May 1912 (syntype of *Ligustrum phillyrea;* ex Léveillé); haut plateau de Ta-hai-tse, 3200 m., *E. E. Maire,* May [1912], "petit arbre à feuilles persistantes, fl. blanches" (on same sheet with the specimen from Io-chan).

Ligustrum phillyrea has been identified with *Osmanthus Delavayi* in the Herbarium at Edinburgh according to a note on the cover of the specimen. I have not seen the specimen from Pe-long-tsin. On the same sheet with the syntype from Io-chan there is another label cited above; the three branches on this sheet are in bloom and exactly alike, so that it is not possible to say which came from Io-chan and which from Ta-hai-tse.

Chionanthus retusa Lindley & Paxton in Paxton Flow. Gard. III. 85, fig. 273 (1853). — Nakai, Fl. Sylv. Kor. x. 16, t. 1, fig. a-c (1921).

Chionanthus retusa var. *Mairei* Léveillé in Fedde, Rep. Spec. Nov. XIII. 175 (1914); Cat. Pl. Yun-Nan, 179 (1916). — **Synon. nov.**

CHINA. Yunnan: environs de Tong-tchouan, 2700 m., *E. E. Maire,* May 1911 (holotype of *C. retusa* var. *Mairei;* ex Léveillé); rochers en face de Pi-ka-ting, 2500 m., *E. E. Maire,* May (1911-13).

I have not seen the holotype of Léveillé's variety, but another specimen from the Léveillé herbarium cited above, which bears in his handwriting the name given by Léveillé. There is also a specimen of *Ch. retusa* from Korea (Faurie no. 517) in the Léveillé herbarium which Léveillé has named in honor of the collector, but later reduced to a variety of *Ch. retusa* and apparently never published.

Chionanthus retusa var. **coreana** (Lévl.) Nakai in Tokyo Bot. Mag. XXXII. 115 (1918); Fl. Sylv. Kor. x. 17, t. 1, fig. d (1921).

Chionanthus coreanus Léveillé in Fedde, Rep. Spec. Nov. VIII. 280 (1910).

KOREA. Quelpaert: secus torrentes Htepyeng, rare, *E. Taquet,* no. 1515, May 5, 1908 (holotype of *Ch. coreanus;* isotype in A. A.).

This is perhaps best considered only a form of *Ch. retusa.* The species is very variable in the shape of its leaves which may vary in the typical form from emarginate to acute or sometimes slightly acuminate even on the same plant. In its oblong to oblong-lanceolate shape of the leaves the variety is rather distinct, but not all the leaves are as clearly acuminate as shown in Nakai's plate, part of them are obtuse or acute; Léveillé describes the leaves as ovate which does not agree with his measurements, and as obtusish which fits only part of the leaves.

Ligustrum lucidum Aiton, Hort. Kew ed. 2, I. 19 (1810). — Léveillé, Fl. Kouy-Tchéou, 295 (1914); Cat. Pl. Yun-Nan, 181 (1916). — Mansfeld in Bot. Jahrb. LIX. Beibl. 132, p. 49 (1924).

Ligustrum Esquirolii Léveillé in Fedde, Rep. Spec. Nov. x. 147 (1911); Fl. Kouy-Tchéou, 295 (1914). — Mansfeld in Bot. Jahrb. LIX. Beibl. 131, p. 72 (1924). — **Synon. nov.**

Esquirolia sinensis Léveillé in Fedde, Rep. Spec. Nov. x. 441 (1912).

Ligustrum lucidum var. *Esquirolii* Léveillé, Cat. Pl. Yun-Nan, 181 (1916).

CHINA. Kweichou: Lao-ten, *J. Esquirol,* no. 87, June 1904, "fl. blanches" (holotype of *L. Esquirolii;* photo. in A. A.); Pin-tchai, *J. Esquirol,* no. 1577, June 1909, "fl. blanches" (holotype of *Esquirolia sinensis* and *Ligustrum lucidum* var. *Esquirolii;* photo. in A. A.).

Esquirolia sinensis was identified by Léveillé himself with *Ligustrum lucidum* in his Flore du Kouy-Tchéou; two years later in his Cat. Pl. Yun-Nan he distinguished it as a variety of *L. lucidum,* but Mansfeld (l. c.) refers it to *L. lucidum* as a synonym.

Ligustrum japonicum Thunberg, Fl. Jap. 17, t. 1 (1784). — Nakai in Tokyo Bot. Mag. XXXII. 120 (1918); Fl. Sylv. Kor. x. 33, t. 10 (1921). — Mansfeld in Bot. Jahrb. LIX. Beibl. 132, p. 51 (1924).

Ligustrum Taquetii Léveillé in Fedde, Rep. Spec. Nov. x. 378 (1912).

KOREA. Quelpaert: in sylvis Hallaisan, *E. Taquet,* no. 3051, June 1909, "haut 7 à 8 m." (holotype of *L. Taquetii;* photo. in A. A.).

Ligustrum Taquetii has been referred to *L. japonicum* by Nakai and by Mansfeld, but differs from typical *L. japonicum* in the narrow, elliptic-oblong, cuneate, thin leaves. The specimen bears no coriaceous leaves of the previous year, as does all the other Quelpaert material before me, as Taquet nos. 1118, 1119, 1120, 3050, 3052 and 3054, Faurie 721 and 1871, and Wilson 9514, but the inflorescence and the flowers agree well with *L. japonicum.*

Ligustrum sinense Lour. var. **myrianthum** (Diels) Hoefker in Mitt. Deutsch. Dendr. Ges. XXIV. 57 (1915). — Mansfeld in Bot. Jahrb. LIX. Beibl. 132, p. 61 (1924).

Ligustrum Bodinieri Léveillé, Fl. Kouy-Tchéou, 295 (1914). — Mansfeld in Bot. Jahrb. LIX. Beibl. 132, p. 72 (1924).

CHINA. Kweichou: environs de Kouy-yang, bois de Kin-lin-chan et mont du Collège, *E. Bodinier,* no. 2249, May 15 and 18, 1898, "grand arbuste" (syntypes of *L. Bodinieri;* photo. in A. A.); item, route de Pin-yue à Kouy-yang, *L. Martin,* May 18, 1899 (locality given on label of no. 2249).

Ligustrum Bodinieri was identified as *L. sinense* var. *myrianthum* at the Herbarium in Edinburgh according to a note on the cover of the specimen. The type sheet contains two branches apparently from the two localities cited under no. 2249, while Martin's collection is not represented.

Ligustrum Quihoui Carrière in Rev. Hort. 1869, p. 377. — Mansfeld in Bot. Jahrb. LIX. Beibl. 132, p. 63 (1924).

Ligustrum Argyi Léveillé in Mem. Acad. Ci. Art. Barcelona, ser. 3, XII. 557 (Cat. Pl. Kiang-Sou, 17) (1916). — **Synon. nov.**

CHINA. Kiangsu: montagnes, *Ch. d'Argy* [1861-74] holotype of *L. Argyi;* photo. in A. A.).

Ligustrum Argyi has been identified at the Herbarium in Edinburgh with *L. Quihoui;* the name is not mentioned by Mansfeld.

Jasminum floridum Bunge in Mém. Div. Sav. Acad. Sci. St. Pétersb. II. 116 (Enum. Pl. China Bor. 42) (1833). — Kobuski in Jour. Arnold Arb. XIII. 147 (1932).

Jasminum Argyi Léveillé in Mem. Acad. Ci. Art. Barcelona, ser. 3, XII. 557 (Cat. Pl. Kiang-Sou, 17) (1916).

CHINA. K i a n g s u : Le-kien, *Ch. d'Argy,* May [1861-74] (holotype of *J. Argyi;* merotype in A. A.).

Jasminum humile Linnaeus, Spec. Pl. 7 (1753). — Kobuski in Jour. Arnold Arb. XIII. 150 (1932).

Jasminum Mairei Léveillé in Fedde, Rep. Spec. Nov. XIII. 337 (1914); Cat. Pl. Yun-Nan, 179 (1916).

Jasminum Mairei var. *sidcrophyllum* Léveillé, Cat. Pl. Yun-Nan, 179 (1916).

CHINA. Y u n n a n : pâturages des mont à Peling-tsin; 3200 m., *E. E. Maire,* May 1913, "arbuste buissonant, haut 0.60 m., fl. jaunes inodores" (holotype of *J. Mairei;* merotype in A. A.); haut plateau de Tai-hai, 3200 m., *E. E. Maire,* July [1911-13], "arbuste buissonant, haut 0.60 m., fl. roses" (holotype of *J. Mairei* var. *siderophyllum;* merotype in A. A.).

Maire gives the color of the flowers of *J. Mairei* var. *siderophyllum* as rose, but this is apparently an error; the flowers of *J. humile* are always yellow.

Jasminum lanceolarium Roxb. var. **puberulum** Hemsl. in Jour. Linn. Soc. XXVI. 78 (1889). — Kobuski in Jour. Arnold Arb. XIII. 158 (1932).

Jasminum Dunnianum Léveillé in Fedde, Rep. Spec. Nov. XIII. 151 (1914); Fl. Kouy-Tchéou, 293 (1914).

CHINA. K w e i c h o u : Che-ten, *J. Esquirol,* no. 887, June 1906, "arbrisseau, fl. blanches" (holotype of *J. Dunnianum;* merotype in A. A.).

Jasminum sinense Hemsley in Jour. Linn. Soc. Bot. XXVI. 80 (1889). — Kobuski in Jour. Arnold Arb. XIII. 159 (1932).

Lonicera Rehderi Léveillé in Fedde, Rep. Spec. Nov. X. 145 (1911). — Non Merrill (1905).

Lonicera Cavalerici Léveillé, op. cit. XI. 31 (1912); Fl. Kouy-Tchéou, 63 (1914).

Jasminum Bodinieri Léveillé, op. cit. XIII. 151 (1914); Fl. Kouy-Tchéou, 293 (1914).

CHINA. K w e i c h o u : Pan-choui, route de Pin-fa à Tou-yun, *J. Cavalerie,* no. 3038, Apr. 9, 1907 (holotype of *Lonicera Rehderi* and *L. Cavaleriei;* merotype in A. A.); environs de Kouy-yang, mont du

Collège, rocailles, *E. Bodinier*, no. 1890, Sept. 11, 1898 (syntype of *J. Bodinieri*, ex Léveillé); environs de Tsin-gay, Gan-pin, *J. Laborde*, Sept. 1897, "arbuste sarmenteux, fl. jaunes" (syntype of *J. Bodinieri;* merotype in A. A.); environs de Tou-chan, *J. Cavalerie*, July 1897 (syntype of *J. Bodinieri;* merotype in A. A.).

Jasminum polyanthum Franchet in Rev. Hort. 1891, p. 270, fig. 69. — Léveillé in Fedde, Rep. Spec. Nov. XIII. 150 (1914). — Kobuski in Jour. Arnold Arb. XIII. 163 (1932).

Jasminum Blinii Léveillé in Fedde, Rep. Spec. Nov. XIII. 151 (1914); Cat. Pl. Yun-Nan, 179 (1916).

Jasminum Delafieldii Léveillé, Cat. Pl. Yun-Nan, 179 (1916).

CHINA. Kweichou: Gan-chouen, *J. Cavalerie*, no. 3912, May 1912, "liane, fl. blanchâtres" (syntype of *J. Blinii;* merotype in A. A.); Hin-y-hien, *E. Bodinier*, no. 1343, April 10-11, 1898 (syntype of *J. Blinii*, ex Léveillé; haies de Ma-tchang, près Tchen-lin, *J. Esquirol*, April 28, 1906 "très belle fleur en long festons aux haies, rosée à d'intérieur" (holotype of *J. Delafieldii;* photo. in A. A.). Yunnan: environs de Yun-nan-sen, March 18, 1897; plaine de Lo-pin-tchéou, April 7, 1897 (syntype of *J. Blinii;* ex Léveillé).

Jasminum Seguini Léveillé in Fedde, Rep. Spec. Nov. XIII. 151 (1914); Fl. Kouy-Tchéou, 294 (1914). — Kobuski in Jour. Arnold Arb. XIII. 165 (1932).

CHINA. Kweichou: rochers de la cascade aux environs de Hoang-ko-tchou, *J. Seguin* in herb. *Bodinier*, no. 2354, June 9, 1898, "arbuste liane, fl. blanches" (holotype of *J. Seguini;* merotype in A. A.).

Jasminum Duclouxii (Lévl.), comb. nov.

Melodinus Duclouxii Léveillé in Fedde, Rep. Spec. Nov. II. 114 (1906).

Jasminum Schneideri Léveillé in Monde Pl. sér. 2, XVIII. 31 (1916).

Jasminum dumicolum W. W. Smith in Notes Bot. Gard. Edinb. XII. 207 (1920). — Kobuski in Jour. Arnold Arb. XIII. 166 (1932).

CHINA. Yunnan: environs de My-tsao, *F. Ducloux*, no. 112, March 4, 1897, "tiges s'enlaçant aux arbres et buissons, fl. blanches, boutons roses" (holotype of *Melodinus Duclouxii* and *J. Schneideri;* photo. in A. A.); Shweli valley, *G. Forrest*, no. 7926, Shweli-Salween divide, *Forrest*, no. 9346; east of Teng-yueh, *Forrest*, no. 8094; Ma-chang-kai valley, *Forrest* no. 9757 (all syntypes of *J. dumicolum;* isotypes in A. A.).

In the original description of *Melodinus Duclouxii* the species is credited to Kweichou, but My-tsao is apparently in the province of Yunnan. The species is not cited either in the Flore du Kouy-Tchéou or in the

Catalogue des plantes du Yun-Nan. In Monde des plantes (l. c.) Léveillé changed the name *Melodinus Duclouxii* to *Jasminum Schneideri*. On the label of the type-specimen the plant was named *Jasminum* in Ducloux's handwriting; this was crossed out and corrected to *Melodinus* by a different hand, but without specific epithet, and under it appears in Léveillé's handwriting *Jasminum Schneideri* Lévl.

Jasminum Prainii Léveillé in Fedde, Rep. Spec. Nov. x. 148. (1911); XIII. 150 (1914); Fl. Kouy-Tchéou, 294 (1914). — Kobuski in Jour. Arnold Arb. XIII. 167 (1932).

CHINA. K w e i c h o u : route de Pin-fa à Ou-glan, *J. Cavalerie*, Aug. 1908 (holotype; merotype in A. A.).

Jasminum Beesianum Forrest & Diels in Notes Bot. Gard. Edinb. v. 253 (1912). — Léveillé, Fl. Kouy-Tchéou, 293 (1914); in Fedde, Rep. Spec. Nov. XIII. 149 (1914); Cat. Pl. Yun-Nan, 179 (1916). — Kobuski in Jour. Arnold Arb. XIII. 168 (1932).

Jasminum Valbrayi Léveillé in Fedde, Rep. Spec. Nov. XIII. 337 (1914).

CHINA. Y u n n a n : haies, plaine de Tong-tchouan, 2500 m., *E. E. Maire*, May 1913, "arbuste delicat, grimpant, rameaux verts, long 1 à 2 m., fl. d'un rouge carmin" (holotype of *J. Valbrayi;* isotype in A. A.).

Jasminum Valbrayi was already referred as a synonym to *J. Beesianum* by Léveillé in his Catalogue des plantes du Yun-Nan.

Jasminum multiflorum (Burm. f.) Andrews, Bot. Repos. VIII. t. 496 (1807). — Kobuski in Jour. Arnold Arb. XIII. 172 (1932).

Jasminum Esquirolii Léveillé in Fedde, Rep. Spec. Nov. x. 147 (1911); Fl. Kouy-Tchéou, 293 (1914).

CHINA. K w e i c h o u : Hang-tong, *J. Esquirol*, no. 729, Jan. 25, 1906 (holotype of *J. Esquirolii*, ex Léveillé); without precise locality, *J. Esquirol*, no. 949, June 1906, "arbrisseau, fl. blanches" (cited in Fl. Kouy-Tchéou; duplicate in A. A.).

Jasminum amplexicaule Buchanan-Hamilton in Wallich, Num. List. 2853 (1930). — D. Don, Gen. Syst. IV. 60 (1837). — Kobuski in Jour. Arnold Arb. XIII. 173 (1932).

Jasminum laurifolium var. *villosum* Léveillé in Fedde, Rep. Spec. Nov. XIII. 151 (1914); Fl. Kouy-Tchéou, 294 (1914). — **Synon. nov.**

CHINA. K w e i c h o u : gorges du fleuve Hoa-kiang, bord de la route à mi-côte, *E. Bodinier*, April 22, 1897, "arbuste à branches allongées, fleurs blanches" (holotype of *J. laurifolium* var. *villosum;* photo. in A. A.).

The leaves of *J. laurifolium* var. *villosum* are not truncate to subcordate as in typical *J. amplexicaule,* but rounded to broadly cuneate, as in the type of *J. aristatum* Wall. (no. 2853) which is referred as a synonym to *J. amplexicaule* and of which I have a photograph before me; the habit is also very much like that specimen except that the flowers at the end of the lateral branchlets are solitary. The branchlets are only slightly short-pubescent, but the under side of the leaves is loosely covered with short accumbent hairs as in Ford's specimen from Hainan distributed as *J. undulatum.*

LOGANIACEAE

Gardneria multiflora Makino in Tokyo Bot. Mag. VI. 33 (1892), nomen nud.; XV. 103 (1901). — Léveillé, Cat. Pl. Yun-Nan, 171 (1916).

Sabia Esquirolii Léveillé in Fedde, Rep. Spec. Nov. IX. 457 (1911); Fl. Kouy-Tchéou, 379 (1915). — **Synon. nov.**

Paederia Bodinieri Léveillé in Fedde, Rep. Spec. Nov. XIII. 179 (1914).

Marlea Cavaleriei Léveillé, Fl. Kouy-Tchéou, 116 (1914). — **Synon. nov.**

Rhamnus Pasteuri Léveillé, Monde Pl. sér. 2, XVIII. 31 (1916). — **Synon. nov.**

Gardneria chinensis Nakai, Trees Shrubs Jap. I. 316 (1922), nomen: in Tokyo Bot. Mag. XXXVIII. 45 (1924). — **Synon. nov.**

China. K w e i c h o u : sur les rochers, *J. Esquirol,* no. 416, June 1905, "arbrisseau, fl. jaune" (holotype of *Sabia Esquirolii;* merotype in A. A.); Kouy-yang, dans la rocaille de la grotte de la grenouille, *E. Bodinier* no. 2616, June 13, 1899 (syntype of *Paederia Bodinieri* and of *Marlea Cavaleriei;* photo. in A. A.); Pin-fa, rochers près Ouen-pi, *J. Cavalerie,* no. 10bis, May 30, 1902 (syntype of *Paederia Bodinieri* and of *Marlea Cavaleriei;* photo. in A. A.); Kouy-yang, mont du Collège, grandes rocailles, *E. Bodinier,* no. 2315, June 9, 1898, "arbuste à tiges allongées lianeuses, fl. jaunes" (holotype of *Rhamnus Pasteuri;* merotype in A. A.).

Paederia Bodinieri was transferred by Léveillé to *Marlea* as *M. Cavaleriei,* because there exists an older *M. Bodinieri* Lévl.

I cannot find any good specific differences between *G. chinensis* Nakai and the Japanese *G. multiflora* Makino; the ample Chinese material before me shows great variability in the characters mentioned by Nakai and there seems to be no reliable character to separate it from typical *G. multiflora.*

Buddleia asiatica Loureiro, Fl. Cochinch. 72 (1790). — Léveillé, Fl. Kouy-Tchéou, 261 (1914). — Marquand in Kew Bull. Misc. Inform. 1930, p. 195.

Vitex Esquirolii Léveillé, Fl. Kouy-Tchéou, 443 (1915). — **Synon. nov.**

CHINA. Kweichou: Lo-fou, jardin Église, alt. 800 m., *J. Esquirol*, no. 3536, Feb. 1912 (holotype of *Vitex Esquirolii;* photo. and merotype in A. A.).

Vitex Esquirolii was first identified with *Buddleia asiatica* by W. W. Smith according to a note on the type sheet. The synonym is not mentioned by Marquand.

Buddleia acutifolia C. H. Wright in Kew Bull. Misc. Inform. 1896, p. 24. — Marquand in Kew Bull. Misc. Inform. 1930, p. 203.

Buddleia Mairei Léveillé in Fedde, Rep. Spec. Nov. XIII. 258 (1914); Cat. Pl. Yun-Nan, 171 (1916).

CHINA. Yunnan: Mo-tsou, 600 m., *E. E. Maire*, May 1911 (holotype of *B. Mairei;* merotype in A. A.).

Buddleia Mairei was first identified with *B. acutifolia* by Marquand (l. c.).

Buddleia acutifolia f. **albiflora** (Lévl.), comb. nov.

Buddleia Mairei f. *albiflora* Léveillé, Cat. Pl. Yun-Nan, 171 (1916).

YUNNAN: without citation of locality and collector.

There is no specimen named *B. Mairei* f. *albiflora* in the Herb. Léveillé.

Forms of *B. acutifolia* with white flowers have been collected in Yunnan near Tali-fu by G. Forrest (no. 2) and near Yunnan by C. Schneider (no. 45); near Lung-chou, Kwangsi, by Morse (nos. 466, 467), and in Upper Burma by Shaik Mokin (no. 63 in Herb. Hort. Calcutt.).

Buddleia tibetica W. W. Sm. var. **truncatifolia** (Lévl.) Marquand in Kew Bull. Misc. Inform. 1930, p. 205 (1930).

Buddleia truncatifolia Léveillé in Fedde, Rep. Spec. Nov. XIII. 342 (1914); Cat. Pl. Yun-Nan, 171 (1916).

CHINA. Yunnan: haies, vallon de Kiao-tche-keou, 2550 m., *E. E. Maire*, Apr. 1903, "arbuste fragile, feuilles laineuses blanches, fl. roses" (holotype; merotype in A. A.).

APOCYNACEAE

Determined by R. E. WOODSON, JR.

Trachelospermum axillare Hooker f., Fl. Brit. Ind. III. 668 (1882). — Léveillé, Fl. Kouy-Tchéou, 31 (1914).

Melodinus Chaffanjoni Léveillé in Fedde, Rep. Spec. Nov. II. 114 (1906).

Maesa scandens Léveillé in Fedde, Rep. Spec. Nov. X. 375 (1912); Fl. Kouy-Tchéou, 286 (1914). — **Synon. nov.**

Periploca astacus Léveillé, Fl. Kouy-Tchéou, 43 (1914).

China. Kweichou: precise locality lacking, *J. Esquirol,* no. 399, June, 1905, "arbrisseau grimpante; fls. roses, sans odeur" (holotype of *Maesa scandens;* merotype in A. A.); Ma-jo, *J. Cavalerie,* no. 2972, July, 1900 (fruiting holotype of *Periploca astacus;* merotype in A. A.); environs de Kouy-yang, mont du Collège, *J. Chaffanjon,* no. 2302, June 9, 1898, "liane ligneuse; fleurs blanches" (holotype of *Melodinus Chaffanjoni;* photo. in A. A.).

Trachelospermum axillare is a rather frequent liana from northeastern India (Sikkim) to southeast-central China (Hupeh), under which Léveillé himself reduced to synonymy his *Melodinus Chaffanjoni* in Fl. du Kouy-Tchéou, 31 (1914). The synonymy of *Periploca astacus* was first discovered by C. K. Schneider in Sargent, Pl. Wilson. III. 335 (1916).

Trachelospermum gracilipes Hooker f., Fl. Brit. Ind. III. 668 (1882).

Melodinus Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. II. 113 (1912).

Trachelospermum rubrinerve Léveillé, Fl. Kouy-Tchéou, 32 (1914). — **Synon. nov.**

Trachelospermum gracilipes Hook. f. var. *Cavaleriei* (Léveillé) Schneider in Sargent, Pl. Wilson. III. 332 (1916). — **Synon. nov.**

Trachelospermum divaricatum (Thunb.) Kanitz var. *brevisepalum* Schneider in Sargent, Pl. Wilson. III. 338 (1916). — **Synon. nov.**

China. Kweichou: environs de Tou-chan, *J. Cavalerie,* June 3, 1899 (holotype of *Melodinus Cavaleriei;* merotype and photo. in A. A.); Kouy-yang, mont du Collège, *J. Chaffanjon,* April, 1898 (holotype of *Trachelospermum rubrinerve;* merotype in A. A.).

Trachelospermum gracilipes occurs from northeastern India to southeast-central China (Hupeh) upon the continent of Asia, and also upon Formosa and the Liu-kiu Islands. In spite of the wide range, its characters appear too stable to permit varietal segregation at present. Schneider in Sargent, Pl. Wilson. III. 337 (1916) sought to distinguish *T. gracilipes* and *T. divaricatum* upon a fancied slight difference in length of the calyx-lobes, but was obliged to except *T. divaricatum* var. *brevisepalum* in his key to species. A revision of the Asiatic species of *Trachelospermum* is in preparation by the present writer.

Trachelospermum Dunnii Léveillé, Fl. Kouy-Tchéou, 31 (1914); Schneider in Sargent, Pl. Wilson. III. 340 (1916).

Melodium Dunnii Léveillé in Fedde, Rep. Spec. Nov. IX. 453 (1911). sphalm.

Melodinus Dunnii Léveillé, Fl. Kouy-Tchéou, 31 (1914), *in synon.*

China. Kweichou: without locality, *J. Cavalerie* (holotype; merotype in A. A.); Pin-fa, bois de Si-tchéou-gai, *J. Cavalerie,* no. 558,

Sept. 29, 1902 (photo. in A. A.); Pin-fa, *J. Cavalerie,* no. 344, Aug. 31, 1902 (photo. in A. A.); environs de Kouy-yang, mont du Collège, *J. Chaffanjon* in hb. *Bodinier,* April 25, 1898 (fragment and photo. in A. A.); the three last specimens are cited in Fl. du Kouy-Tchéou.

Trachelospermum Dunnii forms a very distinctive element of the genus *Trachelospermum* because of its general, ferruginous indument.

Trachelospermum Bodinieri (Léveillé) Woodson, comb. nov.

Melodinus Bodinieri Léveillé in Fedde, Rep. Spec. Nov. II.. 113 (1912). — **Synon. nov.**

Trachelospermum cathayanum C. K. Schneider in Sargent, Pl. Wilson. III. 333 (1916). — **Synon. nov.**

CHINA. K w e i c h o u : environs de Kouy-Yang, mont. du Collège, *J. Chaffanjon,* no. 2267, May 15, 1898, "liane sous-ligneuse; fleurs blanches" (holotype of *Melodinus Bodinieri;* photo. in A. A.).

This species is one of the most frequently distributed of the genus from southeastern China, and the type specimen (Chaffanjon 2267) agrees closely with that of *T. cathayanum* (Wilson 2348). Unfortunately, several others of the specimens ascribed to *T. cathayanum* by Schneider at the time of original publication are more correctly referable to other species, notably *T. jasminoides* (Lindl.) Lem., *T. crocostomum* Stapf, and *T. gracilipes* Hook. f.

Arduina Carandas (L.) K. Schumann in Engler & Prantl, Nat. Pflanzenfam. IV-2, p. 127 (1895).

Damnacanthus Esquirolii Léveillé in Fedde, Rep. Spec. Nov. X. 435 (1912); Cat. Pl. Yun-Nan, 245 (1915). — **Synon. nov.**

CHINA. Y u n n a n : Kouai-tien, *J. Esquirol,* no. 1508, May 16, 1909 (holotype of *Damnacanthus Esquirolii;* merotype in A. A.).

This species, superficially somewhat reminiscent of the rubiaceous *Damnacanthus,* does not appear to be as frequent in southeastern China as in the adjacent mountains of India. It is notoriously variable.

Wrightia Schlechteri Léveillé in Fedde, Rep. Spec. Nov. XI. 67 (1912); Fl. Kouy-Tchéou, 32 (1914).

CHINA. K w e i c h o u : ruisseau de La-jong, *J. Esquirol,* no. 111, June, 1904, "fleur jaune foncée" (holotype; merotype in A. A.).

This species is referable to the section *Bammatophyton* A. DC. of *Wrightia.* The flowers are dull yellow, with a remarkable corona consisting of five antepetalous oblanceolate-elliptic segments, narrowly acute, entire or subentire, 8-9 mm. long, and five alternating segments, deeply subulate-bifid, 1.5-2.0 mm. long, which are necessary to separate the plants properly from *W. pubescens* R. Br. Apparently the closest

relative of *W. Schlechteri* is *W. sikkimensis* Gamble, which bears scarlet flowers with a somewhat different corona.

Melodinus khasianus Hooker f., Fl. Brit. Ind. III. 629 (1882).

Trachelospermum Esquirolii Léveillé, Fl. Kouy-Tchéou, 32 (1912). — **Synon. nov.**

China. Kweichou: Tchéo-chou, *J. Esquirol,* no. 750, Aug. 1905, "arbrisseau, fleurs blanches" (holotype of *Trachelospermum Esquirolii;* merotype and photo. in A. A.).

The corolla-tube of this plant is very slightly longer than that of the typical representation of the species in northern India, but appears clearly conspecific.

Melodinus Seguini Léveillé in Fedde, Rep. Spec. Nov. II. 114 (1906); Fl. Kouy-Tchéou, 30 (1914).

Melodinus flavus Léveillé in Fedde, Rep. Spec. Nov. XI. 548 (1913). — **Synon. nov.**

Melodinus Esquirolii Léveillé in Fedde, Rep. Spec. Nov. XI. 549 (1913). — **Synon. nov.**

Melodinus edulis Léveillé in Fedde, Rep. Spec. Nov. XI. 549 (1913); Fl. Kouy-Tchéou, 30 (1914). — **Synon. nov.**

China. Kweichou: cascade de Hoangko-chou, sur les rochers, *J. Séguin* in hb. *Bodinier,* no. 2390, June 9, 1898 (holotype of *Melodinus Seguini;* merotype and photo. in A. A.); Ché-ten, *J. Esquirol,* no. 886, June, 1906 (holotype of *M. Esquirolii;* photo. in A. A.); Lo-fou, Aug., 1909; Ly-po, Febr. 1900, *J. Cavalerie,* no. 3412 (holotype of *M. flavus;* in herb. Edinburgh; photo. in A. A.); Gan-chouen, rochers, *J. Cavalerie,* no. 3802 (two sheets, flowering and fruiting), July, 1910 (holotype of *Melodinus edulis;* merotype of flowering specimen and photos. in A. A.).

Much has been made of the faucal corona of *Melodinus* as a specific criterion. Consequently, it is fortunate that flowering material is relatively abundant upon the type sheets of three of Léveillé's species of the genus, now deposited in the herbarium of the Royal Botanic Garden at Edinburgh. Although superficially quite similar, and one might have been pardoned for almost immediately placing them together, a careful scrutiny recently was made of the faucal coronas of two or three flowers from the packets upon each sheet in an effort both to segregate these species if possible and to test the constancy of this character upon specimens of superficially identical aspect.

Two flowers were dissected from Esquirol 886, the type of *M. Esquirolii* Lévl. Within one flower seventeen corona segments were counted with the aid of a binocular dissecting microscope and a Silverman illu-

minator. The segments varied indefinitely from 0.05-0.17 cm. in length; entire, or occasionally bifid or trifid, and oblong-linear in shape. Within the other but twelve segments were found which were all entire, varying from 0.07-0.12 cm. in length. Two flowers also were examined from Cavalerie 3412, the type of *M. flavus* Lévl. The orifice of one bore eleven corona segments, linear-trigonal in shape and 0.12-0.6 cm. long; the other bore sixteen segments of nearly the same shape as those of the first, varying from 0.1-0.45 cm. in length. The segments of the first corona were found occasionally to bear a small tooth-like segment near the base. Within three flowers from Cavalerie 3802, the type of *M. edulis* Lévl. similar variability was manifest. The first corolla contained ten segments rather broadly oblong in shape, entire, and ranging from 0.08-0.12 cm. in length. The second bore twelve segments of roughly similar shape as those of the first, but with occasional, basal teeth as found in one specimen of *M. flavus*. These segments were 0.05-0.15 cm. long. The third flower was found to have twelve segments somewhat more narrowly oblong, entire, or with inconspicuous basal teeth, and 0.08-0.2 cm. long. Although the fragments of Séguin 2390, type of *M. Seguini* Lévl., were insufficient for detailed examination, the available material strongly supports classification with the preceding.

Quite recently another specimen of *Melodinus* has been collected in southern Szechuan (F. T. Wang 23181 in herb. Missouri Bot. Garden) which closely corresponds to the types of Léveillé's species of the same genus which have just been discussed, except with respect to the faucal corona, which consists merely of solitary and very obscure protuberances of unequal size and shape alternating with the corolla lobes. This writer is strongly inclined toward the position that Wang 23181 is referable to the polymorphic species *M. Seguini* Lévl.

With the range of variability of the faucal corona of *Melodinus* as elastic as it has been shown to be, from even the brief examination which has just been outlined, considerable doubt arises as to the use of this character as the basis for fine division of specific units. Nevertheless this criterion has been made the chief key character for the differentiation of ten species of the genus indigenous to French Indo-China by Pitard,[1] who is able to separate them by means of such features of the corona segments as whether present or absent; five or ten; free or united at the base; entire or divided; bifid or multifid, with an implication of regularity manifestly lacking in the four species of the genus discovered by Léveillé in closely neighboring southern China. An intensive evaluation of the species of *Melodinus* is much to be desired.

[1]Pitard in Lecomte, Fl. Gén. Indo-Chine, III. 1101 (1933).

Alstonia yunnanensis Diels in Notes Bot. Gard. Edinb. v. 165 (1912). — Léveillé, Cat. Pl. Yun-Nan, 10 (1915).

Acronychia Esquirolii Léveillé, Fl. Kouy-Tchéou, 374 (1915).

Alstonia Esquirolii Léveillé, Cat. Pl. Yun-Nan, 10 (1915). — **Synon. nov.**

China. Kweichou: ruisseau derrière Bo-ly et chemin de Kéou-tin, *J. Esquirol,* no. 3212, June, 1911 (holotype of *Acronychia Esquirolii;* merotype and photo. in A. A.); precise locality lacking, *J. Esquirol,* no. 740, Aug., 1905 (holotype of *Alstonia Esquirolii;* photo. and merotype in A. A.); Yunnan: sous bois, collines de Mi-tsao, alt. 2000 m., *E. E. Maire,* July, 1911-13, "arbuste, haut 1.20 m." (under *A. yunnanensis* in hb. Léveillé; fragment in A. A.).

Strangely enough, *Acronychia Esquirolii* and *Alstonia Esquirolii* bear no bibliographical relationship. Léveillé apparently realized the proximity of his *Alstonia Esquirolii* to *A. yunnanensis,* but suggested no differentia.

Alstonia Mairei Léveillé, Cat. Pl. Yun-Nan, 9 (1915).

Wikstroemia Hemsleyana Léveillé in Bull. Géog. Bot. xxv. 41 (1915). — **Synon. nov.**

China. Yunnan: rochers de Kiang-ti, alt. 2300 m., *E. E. Maire,* July, 1912, "arbuste, feuilles resistantes, fl. blanches" (holotype of *Alstonia Mairei;* merotype in A. A.); mont. de Mo-tsou, alt. 800 m., *E. E. Maire,* date lacking, "arbuste toujours verte, fl. blanches" (holotype of *Wikstroemia Hemsleyana;* merotype in A. A.).

Closely related to the preceding, but differing notably in the larger flowers and glabrous foliage. Both *A. yunnanensis* and *A. Mairei* are referable to the section Blaberopus of *Alstonia,* having a conspicuous, two-lobed disk, which about equals the ovary in the former, and is somewhat shorter in the latter species.

Aganosma cymosa (Roxb.) G. Don, Gen. Syst. iv. 77 (1838).

Echites cymosa Roxburgh, Fl. Ind. ii. 16 (1832).

Aganosma Schlechterianum Léveillé in Fedde, Rep. Spec. Nov. ix. 325 (1911). — **Synon. nov.**

Trachclospermum Navillei Léveillé, Fl. Kouy-Tchéou, 32, (1914). — **Synon. nov.**

China. Kweichou: rochers à Lao-ten, *J. Esquirol,* no. 100, June, 1904 (holotype of *Aganosma Schlechterianum;* merotype and photo. in A. A.); Lo-hou, buissons, alt. 900 m., *J. Esquirol,* no. 3653, June 1912 (holotype of *Trachelospermum Navillei;* merotype in A. A.).

Apparently rare in southeastern China, this species is of frequent occurrence in the closely neighboring provinces of India. Schneider

(Sargent, Pl. Wilson. III. 336. 1916) referred *T. Navillei* to *Aganosma cymosa* var. *elegans* Hook. f., a variety with purplish flowers from the Malay Peninsula. Léveillé expressly described the flowers of his species as white, coinciding with the typical variety of *A. cymosa* in this particular.

Sindechites Esquirolii (Léveillé) Woodson, comb. nov.

Parameria Esquirolii Léveillé in Fedde, Rep. Spec. Nov. IX. 325 (1911).

CHINA. K w e i c h o u : haies, precise locality lacking, *J. Esquirol,* no. 427, June, 1905, "fl. blanches" (holotype; merotype and photo. in A. A.).

This species differs from *S. Henryi* Oliv. in such characters as the smaller corolla with the tube scarcely three times exceeding the calyx lobes, the ovary nearly twice surpassing the nectaries, the anthers with narrow, subparallel auricles and linear, apical hair-tuft nearly as long as the anther proper inserted slightly below midway within the corolla tube, and the leaves with closer, subhorizontal venation. *Sindechites Henryi* is from the province of Hupeh.

Alyxia Schlechteri Léveillé in Fedde, Rep. Spec. Nov. IX. 453 (1911).

CHINA. K w e i c h o u : Lo-fou, rivière de l'ouest, sud de Tinfan, bois, rochers au sud, *J. Cavalerie,* no. 1871, March, 1904 (holotype; merotype and photo. in A. A.).

Doubtfully distinct from *A. angustifolia* Ridl. which it antedates. Our fragments have been insufficient for critical comparison.

Alyxia Bodinieri (Léveillé) Woodson, comb. nov.

Daphne Bodinieri Léveillé in Fedde, Rep. Spec. Nov. XIII. 258 (1914).

Wikstroemia Bodinieri Léveillé, Fl. Kouy-Tchéou, 417 (1915).

CHINA. K w e i c h o u : environs de Tsin-gay à Tchao-se, bois rocailleux de la montagne, *J. Laborde,* no. 2700, Sept. 7, 1899, "fort arbuste à branches allongées, fl. jaunes" (holotype; merotype in A. A.); same locality, *J. Cavalerie,* no. 1202, July 1903 (cited in Fl. du Kouy-Tchéou; photo. in A. A.).

Near *A. pumila* Hook. f., differing in the pubescent inflorescence and somewhat larger foliage.

DOUBTFUL SPECIES

Trachelospermum Cavaleriei Léveillé, Fl. Kouy-Tchéou, 31 (1914), *"Cavaleri."*

CHINA. K w e i c h o u : ouest de Lo-fou, pente de rivière, *J. Cava-*

lerie, no. 2643, "liane à suc abondant" (holotype; merotype and photo. in A. A.).

The type specimen, consisting of a short branch bearing a pair of linear-fusiform follicles and two leaves, is insufficient for critical determination. It appears unlikely that it represents a species of *Trachelospermum*, because of the unusual shape and venation of the foliage. It is tentatively suggested that it may be referable to the genus *Wrightia*. An annotation upon the original label suggests the possibility of *Sindechites Henryi* Oliv., a species with very different foliage. The fruit of *Sindechites* is unknown.

ASCLEPIADACEAE

Determined by R. E. Woodson, Jr.

Stephanotis yunnanensis Léveillé, Cat. Pl. Yun-Nan, 14 (1915).

China. Yunnan: sous-bois a Tchéou-kia-tse-tang, alt. 2550 m., *E. E. Maire*, June, 1911, "arbuste grimpante, fl. blanches à biseré violet" (holotype; merotype in A. A.).

Six species of the small-flowered section *Jasminanthes* (Blume) Hemsl. of *Stephanotis* are known from eastern Asia and the adjacent archipelagos, among which *S. yunnanensis* may be distinguished as follows:

Corona manifest, the lobes free, adnate to the anthers.
- Corona lobes not surpassing the anthers.
  - Plants manifestly pubescent; corolla lobes equalling or surpassing the tube.
    - Calyx lobes ovate, 5-7 mm. long; plants of southeastern China (Hongkong) ..... *S. chinensis* Champ.
    - Calyx lobes linear, 10 mm. long; plants of the Liukiu Islands. *S. lutchuensis* Koidz.
  - Plants glabrous or virtually so; corolla lobes much shorter than the tube; plants of southwestern China (Yunnan) *S. yunnanensis* Lévl.
- Corona lobes manifestly surpassing the anthers; plants of the Malay Peninsula ..... *S. parviflora* Ridl.

Corona not manifest.
- Corolla lobes equalling or surpassing the tube; plants of the Malay Peninsula ..... *S. Maingayi* Hook. f.
- Corolla lobes shorter than the tube; plants of Borneo *S. suaveolens* (Blume) K. Schum.

Marsdenia yunnanensis (Lévl.) Woodson, comb. nov.

Gongronema yunnanense Léveillé, Cat. Pl. Yun-Nan, 13 (1915).

China. Yunnan: broussailles des collines à Ku-long-tchang, alt. 800 m., *E. E. Maire*, date lacking, "arbuste grimpante, feuilles caduques, fl. blanche rosée" (holotype; merotype in A. A.).

This species finds its most obvious affinities with *M. lucida* Edgew., *M. oreophila* W. W. Smith, and *M. Griffithii* Hook. f., although it is probably most closely related to the first enumerated, differing notably in the few (3-5-)-flowered umbels, and broadly acute corona scales which are conspicuously surpassed by the hyaline tips of the anthers. The Asiatic species of *Marsdenia* are badly in need of a monographic treatment such as that of Rothe for the species of the western hemisphere.

Marsdenia Cavaleriei (Lévl.) Handel-Mazzetti, MS. in herb. Edinburgh, comb. nov.

Metaplexis Cavaleriei Léveillé, Fl. Kouy-Tchéou, 42 (1914).

CHINA. K w e i c h o u : Houa-liang, *J. Cavalerie*, no. 2155, June, 1904 (holotype; photo. in A. A.).

This species is remarkable because of the membranaceous texture of the ovate corona segments.

Hoya carnosa (L.) R. Brown in Mem. Wern. Soc. I. 27 (1809).

Hoya Lyi Léveillé, in Bull. Soc. Bot. France, LIV. 369 (1907). — **Synon. nov.**

CHINA. K w e i c h o u : Tsien-sen-kiao, *J. Ly*, no. 1879, Nov., 1904 (syntype of *H. Lyi;* photo. in A. A.); Lo-pie, rocailles près du marché, *L. Martin & J. Séguin*, no. 1853, Oct. 7, 1897 (syntype of *H. Lyi;* photo. in A. A.).

Hoya Esquirolii Léveillé in Fedde, Rep. Spec. Nov. XI. 298 (1912).

CHINA. K w e i c h o u : Lo-fou, sur arbe, *J. Cavalerie*, no. 3484, March, 1909 (syntype; photo. in A. A.); au bac de Pia-ouai, pend en longues ficelles des rochers et des vieux troncs, *J. Esquirol*, no. 2801, May 20, 1912 (syntype; photo. in A. A.).

Either specimen is without flowers for dissection; consequently a decisive opinion cannot be rendered concerning this plant, the foliage of which resembles to some extent that of *H. nummularia* Dcne., with which it may be conspecific.

CONVOLVULACEAE

Porana sinensis Hemsley in Jour. Linn. Soc. Bot. XXVI. 167 (1890). — Schneider in Sargent, Pl. Wilson. III. 355 (1916).

Porana Esquirolii Léveillé in Fedde, Rep. Spec. Nov. IX. 444 (1911); Fl. Kouy-Tchéou, 114 (1914); Cat. Pl. Yun-Nan, 58 (1916). — **Synon. nov.**

Porana Delavayi Gagnepain & Courchet in Lecomte, Not. Syst. III. 153 (1915). — **Synon. nov.**

Vatica cordata Hu in Jour. Arnold Arb. XI. 225 (1930). — **Synon. nov.**[1]

China. Kweichou: without precise locality, *J. Esquirol,* no. 976 "fleur bleue (peut-être)" (holotype of *P. Esquirolii;* photo. in A. A.); rochers de Lao-ten, *J. Esquirol,* no. 50, May 20, 1904 (cited under *P. Esquirolii* in Fl. Kouy-Tchéou; duplicate in A. A.).

Porana Delavayi is apparently a glabrescent form of *P. sinensis* Hemsl. Léveillé cites it in his Catalogue des plantes de Yun-Nan as a synonym of his *P. Esquirolii* and enumerates under *P. Esquirolii* in his Flore du Kouy-Tchéou Cavalerie's no. 2386 which is one of the syntypes of *P. Delavayi.* The specimens enumerated by Schneider all belong to the glabrescent form which seems to be the common plant in central and western China. The pubescent type, *P. sinensis,* which is based on a specimen from Kwangtung (Ford, no. 290) I have seen only from Kweichou, where it has also been collected by Handel-Mazzetti (no. 10877), and from Kwangsi (R. C. Ching, no. 7426) distributed as *Vatica cordata* Hu. Of the glabrescent forms I have also seen a duplicate of Maire's specimen from Li-tse-pin, Yunnan, one of the syntypes of *P. Delavayi.* As the two forms are easily distinguished and seem to be geographically well separated, the type extending from Kwangtung through Kwangsi to Kweichou, while *P. Delavayi* ranges from Yunnan through Szechuan and Kweichou to Hupeh, the glabrescent variety may be separated as **P. sinensis** var. **Delavayi** (Gagnep.) Rehd., var. nov. To this variety also belongs Esquirol's no. 50 from Lao-ten; whether Cavalerie's no. 2386 belongs here or to the type, I am not sure, since I have not seen this number, but as Gagnepain enumerates it without comment under his *P. Delavayi* I assume that it represents the glabrescent variety.

Porana racemosa Roxburgh, Hort. Bengal. 13 (1814), nom. nud.; Fl. Ind. II. 41 (1824). — Schneider in Sargent, Pl. Wilson. III. 361 (1916). — Léveillé, Cat. Pl. Yun-Nan, 59 (1916).

Porana Gagnepainiana Léveillé, Cat. Pl. Yun-Nan, 58 (1916). — **Synon. nov.**

China. Yunnan: haies de la plaine à Long-ky, 700 m., *E. E. Maire,* June 1912, "arbuste grimpante, fl. blanches" (holotype of *P. Gagnepainiana;* merotype in A. A.).

Argyreia Seguini Vaniot apud Léveillé, Fl. Kouy-Tchéou, 113 (1914); China Revue, 1916, p. 18 (MS.).

[1]The identification of *Vatica cordata* was communicated to me by Professor W. Y. Chun in a letter of Feb. 19, 1931, but I am not aware that this identification has been published.

Lettsomia Seguini Léveillé in Fedde, Rep. Spec. Nov. IX. 452 (1911).
Argyreia Seguini Vaniot in herb. ex Léveillé in Fedde, Rep. Spec. Nov. IX. 452 (1911), pro synon. *Lettsomiae Seguini.*

CHINA. Kweichou: environs de Hoang-ko-chou, dans les rocailles, sur les rochers, *J. Seguin* in hb. *Bodinier,* no. 2438, July 9, 1898 "grande liane sous-ligneuse, bractées florales couleur de chair" (syntype of *Lettsomia Seguini;* photo. in A. A.), and no. 2438bis, Aug. 15, 1898 (syntype of *L. Seguini;* ex Léveillé); rocailles, descente du fleuve, *E. Bodinier,* no. 510, July 28, "liane, fl. blanches" (syntype of *L. Seguini;* photo. in A. A.); Lo-fou, *J. Cavalerie,* no. 3519, April and Aug. 1909 "couleur violette" (probably refers to the bracts) (syntype of *L. Seguini;* photo. in A. A.); route de Pien-yang à Lo-fou, *J. Cavalerie,* no. 2690, Nov. 1905 (syntype of *L. Seguini;* ex Léveillé); Oug-ray, *J. Esquirol,* no. 956, June 1906 "fl. blanche, panachée violet" (syntype of *L. Seguini;* photo. in A. A.).

With Seguin no. 2438 there is a description apparently written by Vaniot which was published with slight changes by Léveillé under *Lettsomia Seguini.*

Argyreia Seguini seems closely related to *A. argentea* Choisy and *A. bracteata* Choisy, but is easily distinguished from the former by the leaves being rounded at the base and glabrous above, by larger and broader pink bracts and white corolla appressed-pubescent outside; from the latter it differs in the leaves being quite glabrous above and villous-tomentose, not silky-strigose beneath, in the broader and larger pink bracts and in the white corolla being appressed-pubescent outside except below the middle of the tube, not hirsute to near the base.

BORAGINACEAE

Ehretia Dunniana Léveillé in Fedde, Rep. Spec. Nov. XI. 65 (1912); Fl. Kouy-Tchéou, 53 (1914).

CHINA. Kweichou: Lo-fou, *J. Cavalerie,* no. 3479, March 1909 (holotype; photo. in A. A.).

Ehretia Dunniana is similar to *E. longiflora* Champ. but differs in the linear-oblong anthers about 1.75 mm. long, in the filaments shorter than the style, in the pubescent calyx and the more densely pubescent inflorescence.

VERBENACEAE

Callicarpa macrophylla Vahl, Symb. III. 13, t. 53 (1794). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 23 (Verben. China) (1932).

Callicarpa Dunniana Léveillé in Fedde, Rep. Spec. Nov. IX. 456 (1911).

Callicarpa macrophylla var. *Kouytchensis* Léveillé, Fl. Kouy-Tchéou, 440 (1915), sine descript. — **Synon. nov.**

China. Kweichou: environs de Hoang-ke-chou, vallée de Ko-lin-kiao (Tchen-lin), *J. Seguin* in hb. *Bodinier*, no. 2439, June 20, 1898, "arbuste à fleurs d'un violet-pourpre (syntype of *C. Dunniana;* photo. in A. A.); Long-chan *J. Esquirol*, no. 869, June 1906, "fleurs rouges" (syntype of *C. Dunniana;* merotype in A. A.); sud du Kouy-tchéou, *J. Cavalerie*, no. 2703, Nov. 1905, "1 à 2 m. de haut, fruit mûr d'un blanc de neige" (syntype of *C. macrophylla* var. *Kouytchensis;* photo. in A. A.); autour de l'église de Lo-fou, *J. Esquirol*, no. 3093, July, Sept. 1911, "fl. rouge, fruits blancs." (syntype of *C. macrophylla* var. *Kouytchensis;* photo. in A. A.).

Callicarpa Dunniana was first referred to *C. macrophylla* by P'ei, but no. 2439 in hb. Léveillé was already named *C. macrophylla* Vahl by Bodinier. On the label of his no. 2703 Cavalerie gives the following information: "plante de 1 à 2 m. de haut que les Chinois appellent jan-fau-houa (= teindre-riz-fleur), parce qu'il sen servent pour colorer leur gateaux de riz."

Callicarpa Bodinieri Léveillé in Fedde, Rep. Spec. Nov. IX. 456 (1911); Fl. Kouy-Tchéou, 439 (1915).

Callicarpa Seguini Léveillé in Fedde, Rep. Spec. Nov. IX. 455 (1911); Fl. Kouy-Tchéou, 440 (1915).

Callicarpa Feddei Léveillé in Fedde, Rep. Spec. Nov. X. 439 (1912); Fl. Kouy-Tchéou, 439 (1915).

Callicarpa Giraldiana Hesse var. *subcanescens* Rehder in Sargent, Pl. Wilson. III. 368 (1916). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 34 (Verben. China) (1932). — **Synon. nov.**

China. Kweichou: environs de Gan-pin, rochers, aux Grandes Rocailles, *L. Martin* in herb. *Bodinier*, no. 1996, Oct. 28, 1897, "fruits d'une belle couleur violacée" (syntype of *C. Bodinieri*, photo. in A. A.); environs de Gan-pin, torrent des Ligularia, *L. Martin* in herb. *Bodinier*, no. 2365, June 19, 1898, "arbuste, fl. violettes (syntype of *C. Bodinieri;* merotype in A. A.); Pin-fa, *J. Cavalerie*, no. 1095, June 23, 1923 (syntype of *C. Bodinieri;* photo. in A. A.); without precise locality, *J. Esquirol*, no. 468, June 1905 (holotype of *C. Feddei;* merotype in A. A.). Hupeh: without precise locality, *A. Henry*, no. 5864 (holotype of *C. Giraldiana* var. *subcanescens;* in Gray Herb.).

Callicarpa Bodinieri is the oldest name for that very variable species generally known as *C. Giraldiana* and agrees with its pubescent form described as var. *subcanescens*. The type of the latter is slightly more pubescent than Bodinier's no. 2365, one of the syntypes of *C. Bodinieri* and that which should be considered the type (lectotype) of the species, because it is from Bodinier's herbarium and is represented by ample flowering material, while no. 1996 is in fruit; the third syntype was col-

lected by Cavalerie and has the older leaves glabrescent, approaching those of var. *Giraldii*. *Callicarpa Feddei* hardly differs from the type except that the leaves are narrower and smaller. The type of *C. Giraldiana* var. *subcanescens* is somewhat more densely pubescent and agrees in this respect with *C. Seguini*. It seems hardly possible to draw a clear line between the pubescent type and the glabrescent var. *Giraldii*, since they are connected by intermediate forms; the densely pubescent var. *Lyi* is more distinct particularly in its pubescent corolla.

Callicarpa Bodinieri Lévl. var. **Lyi** (Lévl.), stat. nov.

Callicarpa Lyi Léveillé in Fedde, Rep. Spec. Nov. x. 439 (1912); Fl. Kouy-Tchéou, 439 (1915).

Callicarpa grisea Handel-Mazzetti in Anz. Akad. Wiss. Wien, 1921, p. 230 (Pl. Nov. Sin. Forts. 14, p. 4) (1921). — **Synon. nov.**

CHINA. K w e i c h o u : Pin-fa, *J. Cavalerie*, no. 1026, June 3, 1903, "fleurs pourpres rouges" (holotype of *C. Lyi;* photo. and merotype in A. A.). K w a n g s i : circa carbonis minas, 600 m., *Wang-Te-Hui*, Pl. Sin. cur. Handel-Mazzetti, no. 182, spring 1920 (holotype of *C. grisea;* isotype in A. A.).

This at the first glance looks like a distinct species with the grayish white tomentum of the under side of the leaves, of the stem and the inflorescence including the calyx and corolla, but in all other characters it agrees with typical *C. Bodinieri*. By P'ei it is referred to *C. Giraldiana* var. *subcanescens* as a synonym, but is easily distinguished by the much denser whitish pubescence, particularly the upper part of the corolla is fairly densely pubescent outside, while in the type only scattered stellate hairs are present or often entirely lacking.

Besides the specimens cited above W. P. Fang's no. 1235 from Szechuan and L. H. Bailey's specimens collected June 18, 1917 on the Chikungshan, Hupeh-Honan border, belong here.

Callicarpa Bodinieri Lévl. var. **Giraldii** (Rehd.), comb. nov.

Callicarpa Giraldii "Hesse" Rehder in Bailey, Stand. Cycl. Hort. II. 629 (1914).

Callicarpa Giraldiana Hort. Hesse apud Schneider, Ill. Handb. Laubholzk. II. 1048 (July 1912), nom. nud. — Hesse in Mitt. Deutsch. Dendr. Ges. XXI. 366, 2 figs. (after August 1912), sine descript. — Rehder in Sargent, Pl. Wilson. III. 366 (August 1916). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 23 (Verben. China) (1932).

Callicarpa Mairei Léveillé, Sert. Yunn. 2 (July 1916). — Cat. Pl. Yun-Nan, 297 (1917).

CHINA. Y u n n a n : forêts des coteaux à Tchen-fong-chan, 800 m., *E. E. Maire*, June 1912 "grande arbuste à feuilles persistentes, fl. jaunâtres" (holotype of *C. Mairei;* photo. in A. A.).

This is a glabrescent form of *C. Bodinieri*, while the preceding variety represents the extreme pubescent form of the species. *Callicarpa Bodinieri* var. *Giraldii* was based originally on cultivated specimens raised in the nursery of H. A. Hesse at Weener, Germany, from seed sent by G. Giraldi from Shensi or northern Hupeh. The first description appeared in 1914 as *C. Giraldii* (l. c.), though it had been mentioned as *C. Giraldiana* without description two years earlier by Schneider (l. c.) and in the same year a few months later photographs of flowering and fruiting branches were published by Hesse, but without description. A Latin description as *C. Giraldiana* appeared in 1916 in Plantae Wilsoniana (l. c.). Therefore the valid publication of the species as *C. Giraldii* dates from 1914, though the name *C. Giraldiana* has been generally adopted for it.[1]

Callicarpa Dielsii (Lévl.) P'ei in Mem. Sci. Soc. China, I. no. 3, p. 37 (Verben. China) (1932).

Viburnum Dielsii Léveillé in Fedde, Rep. Spec. Nov. IX. 443 (1911); Fl. Kouy-Tchéou, 66 (1914).

China. Kweichou: Pin-fa, *J. Cavalerie*, no. 385, Sept. 4, 1902 (holotype; photo. in A. A.).

This species is very close to the following, but differs chiefly in its pubescence of simple or nearly simple hairs.

Callicarpa rubella Lindl. var. **Hemsleyana** Diels in Bot. Jahrb. XXIX. 547 (1900). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 40 (Verben. China) (1932).

Callicarpa panduriformis Léveillé in Fedde, Rep. Spec. Nov. IX. 455 (1911); Fl. Kouy-Tchéou, 440 (1915).

China. Kweichou: environs de Kouy-yang, mont du Collège, *J. Chaffanjon* in hb. *Bodinier*, no. 2341bis, May 1898, "grande arbuste" (syntype of *C. panduriformis;* photo. in A. A.); environs de Tsin-gay, haies, bois de la montagne, *J. Laborde* in hb. *Bodinier*, no. 2507, Nov. 20, 1898, "jolies baies rouges (syntype of *C. panduriformis;* photo. in A. A.).

Callicarpa panduriformis was first identified with *C. rubella* var. *Hemsleyana* by P'ei.

[1] **Callicarpa Bodinieri** var. **Rosthornii** (Diels), comb. nov.

Callicarpa longifolia var. *Rosthornii* Diels in Bot. Jahrb. XXIX. 548 (1900).

Callicarpa Giraldiana var. *Rosthornii* (Diels) Rehder in Sargent, Pl. Wilson. III. 367 (1916). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 37 (Verben. China) (1932).

This variety which has been found in Szechuan and Kwangsi differs from typical *C. Bodinieri* chiefly in its smaller and narrower leaves.

Callicarpa dichotoma (Lour.) Raeuschel, Nomencl. ed. 3, p. 37 (1797). — P'ei in Mem. Sci. Soc. China I. no. 3, p. 51 (Verben. China) (1932).

Callicarpa Taquetii Léveillé in Fedde, Rep. Spec. Nov. XII. 182 (1913). — **Synon. nov.**

KOREA. Quelpaert: in silvis, *E. Taquet*, no. 5876, July 1911 (holotype of *C. Taquetii;* merotype in A. A.).

Premna parvilimba P'ei in Mem. Sci. Soc. China I. no. 3, p. 62 (Verben. China) (1932).

Celastrus yunnanensis Léveillé, Cat. Pl. Yun-Nan, 32 (1915).

CHINA. Yunnan: rochers, pied des montagnes a Kiao-kiao, 400 m., *E. E. Maire*, June 1911, "arbuste feuilles persistantes, fl. roses" (holotype of *Celastrus yunnanensis;* photo. and merotype in A. A.).

Celastrus yunnanensis was first referred to *Premna* by the writer and later recognized as a distinct species by P'ei, who described it as *C. parvilimba*, since there exists already a *P. yunnanensis* W. W. Sm.

Premna Bodinieri Léveillé in Fedde, Rep. Spec. Nov. X. 440 (1912); Fl. Kouy-Tchéou, 443 (1915). — P'ei in Mem. Sci. Soc. China I. no. 3, p. 80 (Verben. China) (1932).

CHINA. Kweichou: gorges de Hao-kiang, à la descente à mi-cote, *E. Bodinier*, no. 1583, April 22, 1897, "arbuste à branches allongées, fl. blanches ou blanc-jaunes" (holotype; fragment in A. A.).

Premna puberula Pampanini in Nuov. Giorn. Bot. Ital. n. ser. XVII. 701 (1910). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 85 (Verben. China) (1932).

Premna Martini Léveillé in Fedde, Rep. Spec. Nov. X. 440 (1912); Fl. Kouy-Tchéou, 443 (1915).

CHINA. Kweichou: environs de Kouy-yang, plaine et montagne dans les haies, *E. Bodinier*, no. 2217, May 18 and 26, 1899, "petit arbuste, fl. jaunâtres" (holotype of *P. Martini;* photo. in A. A.).

Premna Martini was first referred to *P. puberula* by W. W. Smith according to a note on the type specimen.

Premna Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. X. 439 (1912); Fl. Kouy-Tchéou, 443 (1915). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 87 (Verben. China) (1932).

CHINA. Kweichou: Pin-fa, *J. Cavalerie*, no. 3101, July 2, 1907, "grande arbre, fl. jaune, sale" (holotype; merotype in A. A.).

Clerodendron Bungei Steudel, Nomencl. ed. 2, I. 382 (1840).

Clerodendron foetidum Bunge in Mem. Sav. Etr. Acad. Sci. St.

Pétersb. II. 126 (Enum. Pl. Chin. Bor. 52) (1833). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 138 (Verben. China) (1932). — Non D. Don.

Pavetta Esquirolii Léveillé in Fedde, Rep. Spec. Nov. XIII. 178 (1914); Fl. Kouy-Tchéou, 371 (1915).

China. Kweichou: Tchéou-mao-tan, *J. Esquirol*, no. 805, July 30, 1905 (syntype of *Pavetta Esquirolii;* photo. in A. A.). Yunnan: vallée de Hong-lou, 600 m., *E. E. Maire*, June 1912 (syntype of *Pavetta Esquirolii*, photo. in A. A.).

Pavetta Esquirolii was referred to *Clerodendron Bungei* by the writer and also at Edinburgh according to an undated note on Maire's specimen and doubtfully placed under *C. foetidum* by P'ei.

Besides the characters mentioned by P'ei to distinguish *C. fragrans* and *C. Bungei* the calyx-teeth seem to present good character; they are lanceolate and long-acuminate in the former and triangular-ovate and acute in the latter.

Clerodendron japonicum (Thbg.) Sweet, Hort. Brit. 322 (1826). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 140 (Verben. China) (1932).

Clerodendron Darrisii Léveillé in Fedde, Rep. Spec. Nov. XI. 301 (1912).

Clerodendron Esquirolii Léveillé, l. c. 302 (1912), non p. 298.

Clerodendron Leveillei Fedde apud Léveillé, Fl. Kouy-Tchéou, 442 (1915).

China. Kweichou: Lo-fou, *J. Cavalerie*, no. 3490, Aug. 1909 "arbre" (holotype of *C. Darrisii;* merotype in A. A.); route de Pe-tien à Lo-yen, *J. Esquirol*, no. 123, July 1904, "arbrisseau de 1-2 m., sans division, sommité ecarlate" (holotype of *C. Esquirolii;* merotype in A. A.).

Clerodendron Darrisii and *C. Esquirolii* are enumerated as synonyms of *C. Leveillei* Fedde by Léveillé in his Flore du Kouy-Tchéou, the name *C. Esquirolii* based on Esquirol's no. 123 having been changed to *C. Leveillei* Fedde on account of the homonym published a few pages ahead and based on Esquirol's no. 2802 which was referred by the writer to *Tacca Paxiana* Limpr. (see note by P'ei in Mem. Sci. Soc. China, I. no. 3, p. 162).

Clerodendron mandarinorum Diels in Bot. Jahrb. XXIX. 549 (1900). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 145 (Verben. China) (1932).

Clerodendron Bodinieri Léveillé in Fedde, Rep. Spec. Nov. IX. 325 (1911); Fl. Kouy-Tchéou 441 (1915).

Clerodendron Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. X. 439 (1912).

Clerodendron Bodinieri var. *Cavaleriei* Léveillé, Fl. Kouy-Tchéou. 441 (1915).

CHINA. K w e i c h o u : environs de Gan-pin, *L. Martin* in hb. *Bodinier*, no. 1721, July 27, 1897, "petit arbre, fl. blanches" (syntype of *C. Bodinieri*, merotype and photo. in A. A.); Kouy-yang, le long des ramparts et devant la chapelle, N. D. de Liesse, *C. Martin* in hb. *Bodinier*, no. 1721, Aug. 2, 1899 (syntype of *C. Bodinieri;* photo. in A. A.); Tchéou-pao-tong, *J. Esquirol*, no. 788, July 23, 1905 (syntype of *C. Bodinieri;* photo. in A. A.); Pin-fa, *J. Cavalerie*, nos. 70 and 167, July 19 and Aug. 12, 1902 (syntypes of *C. Cavaleriei;* photos. in A. A.); Pe-piang, *J. Esquirol*, no. 3722, Aug. 20, 1912, "fleurs blanches" (cited under *C. Bodinieri* var. *Cavaleriei* in Fl. Kouy-Tchéou; duplicate in A. A.).

Clerodendron Bodinieri and *C. Cavaleriei* were first referred to *C. mandarinorum* by P'ei. This species has been collected in Kweichou also by Handel-Mazzetti (no. 10884), by Y. Tsiang, nos. 7374 and 8528) and by Steward, Chiao and Cheo (no. 730).

Caryopteris paniculata (Kurz) C. B. Clarke in Hooker f., Fl. Brit. Ind. IV. 597 (1885). — P'ei in Mem. Sci. Soc. China, I. no. 3, p. 176 (Verben. China) (1932).

Callicarpa Martini Léveillé in Fedde, Rep. Spec. Nov. IX. 455 (1911); Fl. Kouy-Tchéou, 440 (1915).

CHINA. K w e i c h o u : environs de Hoang-ko-chou, bord du gave, *L. Martin*, no. 2562, Feb. 12, 1899 (holotype of *C. Martini;* photo. in A. A.); Hang-tong, *J. Esquirol*, nos. 304 and 754, Jan. 1905 (cited under *C. Martini* in Fl. Kouy-Tchéou; (photo. of no. 754 and merotype of no. 304 in A. A.).

Callicarpa Martini was first referred to *Caryopteris paniculata* by P'ei (l. c.). In Flore du Kouy-Tchéou Esquirol's numbers are cited as 304 and 654, but the second number should read 754, as it appears on the type specimen.

(*To be continued*)

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THE CAMBIUM AND ITS DERIVATIVE TISSUES NO. X. STRUCTURE, OPTICAL PROPERTIES AND CHEMICAL COMPOSITION OF THE SO-CALLED MIDDLE LAMELLA

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With two text figures and plates 110-113

INTRODUCTION

MUCH HAS BEEN WRITTEN during the last hundred years concerning the structure, the development, and the physical and chemical properties of the cell wall. A careful study of this literature reveals many varied and more or less contradictory points of view. For example, there is no consensus of opinion concerning the use of such terms as *intercellular substance, middle lamella, primary wall, secondary wall, tertiary wall,* etc. Each of them is employed in several fundamentally different senses and to designate entirely different structures. It is essential to clarify this situation, since the existing confusion results in serious discrepancies, not only in descriptive morphological work, but also in physiological, biophysical, and biochemical investigations.

WHAT CONSTITUTES THE SO-CALLED MIDDLE LAMELLA?

Von Mohl (18) and the earlier botanical investigators believed that the cells of the xylem and of other tissues are bound together by a refractive intercellular substance which differs from the cell walls in its solubilities and other properties. Subsequently, with the discovery of cell division and an altered viewpoint regarding the origin and development of cells, this refractive layer was referred to by Hofmeister (14), Sachs (22), and many other botanists, as the middle lamella. The cytological investigations of Treub (32), Strasburger (30), Timberlake (31), and Allen (1) ultimately led to the conclusion that the middle lamella originates between the halves of the split cell-plate and is, in fact, the first-formed membrane or partition wall, more or less modified in thickness and in chemical composition during tissue differentiation.

Most botanists have differentiated the middle lamella by its refractive character, its differential staining, or its solubility in macerating agents. Dippel (9) demonstrated, however, in the first edition of "Das Mikroskop" that the refractive layer, which appears more or less homogeneous in white light, consists of three distinct layers, i. e., two anisotropic layers and an intervening isotropic layer, *Fig. 5*. He designated the anisotropic layers as primary walls and the isotropic central layer as intercellular substance, the three layers combined constituting the middle lamella. More recently there has been a tendency, among certain investigators, to limit the term middle lamella to the putative isotropic layer. Thus, Ritter (19) has defined the middle lamella as "the isotropic peripheral layer of the cell wall, including the irregular masses of isotropic material commonly found where three or more cells adjoin." Van Iterson (33) similarly differentiates the central isotropic layer as the original or "true middle lamella" and refers to Dippel's middle lamella as the "compound middle lamella."

Mangin (15, 16) demonstrated that the middle lamella of soft tissues is composed of pectic substances, and that "pectose" is intimately associated with cellulose in cell walls which have not been modified by lignification, suberization, etc. He inferred, from macerations of meristematic tissues, that the original partition membrane is of pectic composition and that cellulose is first deposited during the process of secondary thickening. In recent years, Ritter (19), Harlow (12), and others have emphasized the fact that a large proportion of the lignin in wood is located in the middle lamella. Furthermore, Schorger (28) and Ritter (20) consider that the middle lamella is actually composed of lignin.[1]

In view of the existing confusion concerning what constitutes the so-called middle lamella and regarding its physical and chemical constitution, it seemed desirable to the writers to undertake an extensive investigation of various tissues in an endeavor to clarify the situation. In order to have a clear conception of the so-called middle lamella in the mature xylem, it is necessary to consider the conditions in the cambium and the changes which take place during tissue differentiation. The results of a detailed study of the cambium and of its differentiating and fully differentiated derivatives are recorded in the following pages.

[1]It should be noted in this connection, in view of various criticisms of botanical workers, that not only did Schacht (24), Strasburger (29), Dippel (10), and many other botanists subject sections of tissues to chemical treatments, but also that they were cognizant of the fact that the middle lamella of woody tissues is insoluble in concentrated sulphuric acid and in Schweizer's reagent.

MATERIAL AND METHODS

In our work on the cambium, the following species were studied:

1. Pinus Strobus L.
2. Juniperus virginiana L.
3. Thuja occidentalis L.
4. Robinia Pseudoacacia L.
5. Cladrastis lutea (Michx. f.) Koch
6. Fraxinus americana L.
7. Acer rubrum L.
8. Catalpa speciosa Warder
9. Liquidambar Styraciflua L.

Most of the original observations were made on *Pinus Strobus,* but every phase of the work was checked and rechecked on other species. In dealing with the cambium, it is essential to secure freshly collected material from living trees. This is due to the fact that cambial walls contract so much during dehydration that permanent preparations present a caricature of the original structure.

Transverse and longitudinal sections of the wood of more than 800 genera of gymnosperms and angiosperms were examined in polarized light. The following species were selected for subsequent microchemical investigation.

1. Pinus Strobus L.
2. P. radiata D. Don
3. Taxodium distichum (L.) Richard
4. Sequoia sempervirens Endl.
5. Libocedrus decurrens Torr.
6. Trochodendron aralioides Sieb. & Zucc.
7. Ulmus americana L.
8. Tilia glabra Vent.
9. Quercus agrifolia Née
10. Q. Douglasii Hook. & Arn.
11. Prosopis juliflora DC.
12. Citrus Limonia Osbeck
13. Betula papyrifera Marsh.
14. Populus grandidentata Michx.
15. P. trichocarpa Torr. & Gray
16. Nyssa sylvatica Marsh.
17. Robinia Pseudoacacia L.
18. Liquidambar Styraciflua L.
19. Catalpa speciosa Warder
20. Fraxinus mandshurica Rupr.

21. Rhizophora mangle L.
22. Myodocarpus simplicifolius Brong. & Gris
23. Protomegabaria Stapfiana Hutch.
24. Homalium guianense (Aubl.) Warb.
25. Brackenridgea Hookeri A. Gray
26. Tetramerista glabra Miq.

The last six species are tropical forms which were used for comparison with the species of warm-temperate and cold-temperate regions. Sections were made either from freshly collected wood or from seasoned wood soaked in cold water. No softening agents were employed, as these change the chemical properties of the cell walls.

In studying the optical properties of wood, thin and truly transverse sections of straight-grained specimens are essential. Most of the critical work with polarized light was done on sections 5 μ in thickness. Thicker or slightly oblique sections obscure the finer details and give much distorted images. Chemical tests were made on sections 5 to 15 μ in thickness, depending upon the ease with which the material could be cut.

THE CAMBIUM

Since 1900, most botanists have visualized the cambium as an extremely delicate and very thin-walled tissue. Such a conception is due largely to the study of fixed and dehydrated material and to unfamiliarity with the investigations of Sanio (23), Schacht (25), Strasburger (29), Dippel (10), and others who worked with freshly cut and undehydrated material. Sanio (23) demonstrated that the radial walls of the fusiform initials in the cambium of *Pinus sylvestris* are of considerable thickness and that those of adjacent cells are separated by an amorphous intercellular layer or "Zwischensubstanz." Sanio (23) and others erred, however, in their assumption that the occurrence of a "Zwischensubstanz" is an unusual phenomenon in meristems and involves the splitting of an originally entire and homogeneous partition membrane. If they had devoted more attention to the study of ray initials and to the cambia of dicotyledons, they might have recognized the fact that each initial is enclosed, *on all sides,* within a wall of its own which is separated from the walls of adjoining cells by more or less intercellular material. The cambial wall expands as the initial increases in size. The intercellular material is a plastic colloidal substance that passes readily into a semi-liquid phase, thus facilitating those movements and adjustments of cells which are such characteristic features of the actively growing cambium.[1]

[1]For a discussion of these and other phenomena and a description of techniques employed in studying the living cambium, the reader is referred to preceding papers of this series, Bailey (2, 3, 4), and Bailey and Zirkle (5).

In other words, the wall of the cambial initials is a discrete morphological structure which, once formed, maintains its identity under all conditions of growth and development, whereas the intercellular layer is passively molded into various forms and possesses few of the attributes of a true membrane.

Dippel (10) concluded, in the second edition of "Das Mikroskop," that the walls of the cambium are isotropic. He figured (Part II, page 573) a transverse section of the cambium and its derivatives as seen in polarized light with crossed nicols. The walls of the initials and of the enlarging derivatives are dark, whereas the "primary walls," formed during the later stages of the differentiation of the xylem and phloem, are brilliant. This was in line with Dippel's contention that the cambial walls—which are incorporated in the isotropic "intercellular substance" of mature tissues—are composed of "pectose," whereas the subsequently formed "primary walls" consist largely of cellulose.

In view of the accuracy of Dippel's delineations of polarized light pictures of mature tissues, which are much superior to those of recent workers, it is difficult to understand how he could have been led so far astray in his treatment of the cambium. *Figure 1* is a transverse section of the actively growing cambium of *Pinus Strobus,* photographed in polarized light with crossed nicols. Although there is a more intense anisotropy in the region of the xylem than in the cambial zone, the walls of the meristematic cells and of their enlarging derivatives obviously exhibit double refraction. *Figure 2* is a tangential longitudinal section of the cambium of *Fraxinus americana,* likewise photographed in polarized light with crossed nicols. It is evident that the walls of both ray initials and fusiform initials are birefringent. Furthermore, an examination of transverse and longitudinal sections of the cambia of a wide range of gymnosperms and angiosperms indicates that all cambial walls are anisotropic, but that the intensity of double refraction, angles of extinction, etc. vary somewhat from plant to plant. The anisotropy is not due to "rod" or "plate" double refraction, since the walls are birefringent even when they are saturated with a liquid of the same refractive index as their own (Frey, 11). The intercellular substance, on the contrary, is truly isotropic and is dark at all angles and in all planes of section. *Figure 3,* a highly magnified portion of a thin tangential, longitudinal section of the cambium of *Pinus Strobus,* shows the anisotropic walls of two adjacent fusiform initials and the dark isotropic intercellular material between them.

It should be noted, in this connection, that cambial walls are characterized by having more or less numerous plasmodesmata which may be

uniformly distributed or aggregated in thinner areas of the walls, i. e., in so-called primary pit-fields. These primary pit-fields are more closely approximated in the radial walls of the fusiform initials of most dicotyledons, *Figure 4*, than they are in the case of gymnosperms, *Figure 3*. Thus, the walls have a beaded appearance in sectional view, *Figures 2, 4*, and *11*. The intercellular material is much reduced in amount in the region of the primary pit-fields and between the tangential walls of the fusiform initials of gymnosperms, but its presence may be clearly demonstrated by adequate modern techniques.

Our investigations of the cambium indicate that the isotropic intercellular material is composed largely of polyuronides and contains little or no cellulose, and that the anisotropic cambial walls contain both cellulose and polyuronides. When freshly cut sections of the living cambium are subjected to standard chemical treatments used in the extraction of pectic compounds, e.g., ammonium oxalate or dilute acids followed by dilute alkalis, the intercellular material dissolves, leaving the dissociated cambial walls, which are anisotropic and give a typical blue color with chloro-zinc iodide or iodine and sulphuric acid. The dissociated cambial walls are insoluble in 30% sodium hydroxide, or after prolonged treatments in hot dilute acids followed by alkalis, but dissolve completely in such standard solvents of cellulose as 72% sulphuric acid or Schweizer's reagent. When freshly cut sections of the cambium are used, the walls are also completely soluble in 72% sulphuric acid which dissolves both cellulose and polyuronides, but when treated with Schweizer's reagent, there remains a swollen residue of the cambial walls which is isotropic and no longer produces a blue color with iodine and sulphuric acid. This residue stains intensely with ruthenium red[1] and disappears in standard solvents for pectic compounds.

The physical properties, chemical solubilities, and colorations with ruthenium red, chloro-zinc iodide, and iodine-sulphuric acid indicate, therefore, that cambial walls are composed of a mixture of cellulose and polyuronides, and that they are separated by intercellular material which consists largely, if not entirely, of polyuronides. In other words, our observations and analyses are in substantial agreement with those of Mangin (16), Carré and Horne (7), and many others who have dealt with other types of soft, unlignified tissues. Furthermore, we have worked, during the last two years, in close coöperation with Professor Ernest Anderson, who has extracted the polyuronides from the cambium and young phloem of *Robinia Pseudoacacia* and has determined that they are of a pectic nature.

[1]For a discussion of the significance of the ruthenium red reaction see page 340.

The walls of cambial initials are characterized, from a physiological point of view, by their capacity for growth and expansion and for undergoing various reversible changes, e.g., seasonal variations in thickness and in colloidal properties. During the resting season, the cambial walls tend to be thicker and to have the general properties of a firm gel, whereas during the active growing season, they appear to be thinner and more pliable.

TISSUE DIFFERENTIATION

The specific changes that the cambial walls undergo during the differentiation of the xylem and phloem vary markedly, depending upon the particular types of tissue cells that are to be formed. In the case of those parenchymatous elements of the phloem, which retain their capacity for growth and enlargement, the original cambial walls are but slightly modified in form and thickness during tissue differentiation, and no true secondary walls are formed (compare *Figures 10* and *11*).

On the contrary, in the case of tissue cells which undergo irreversible changes and form layers of true secondary wall thickening, the cambial walls and the intercellular material tend to become thinner and considerably modified in form during the process of cell enlargement. Vestiges of the original primary pit-fields and intervening thickenings may persist, however, in parts of cells which are not subjected to excessive expansion. Such vestiges are of common occurrence in the radial walls of the tracheids of most conifers and of the terminal wood parenchyma of many dicotyledons, *Figures 12* and *13*.

The enlargement of those derivatives of the cambium which form tracheids, fiber-tracheids, libriform fibers, and bast fibers involves an increase in the cross-sectional area of the cells and elongation due to apical sliding growth. The cambial wall expands as the cell increases in size, but layers of secondary thickening are not deposited until the cell has attained its mature diameter. As the cambial walls increase in surface area and decrease in thickness, the layer of intercellular material becomes so tenuous that it is difficult to differentiate it by the use of ordinary microscopical methods, except in the angular spaces where three or more cells adjoin. Lignification is initiated during the earlier stages of secondary wall formation, and, in the species studied by us, is first visible in the cambial walls and the intercellular substance. It spreads centripetally through the successively formed layers of the secondary wall. The lignification of the cambial walls is usually very intense, except in the pit-membranes and crassulæ; whereas that of the secondary layers is extremely variable, particularly in dicotyledons.

The difficulty of differentiating the cambial walls from the intercellular material is accentuated by lignification, which alters the staining reactions and the indexes of refraction of the three adjoining layers, and makes them appear as a single homogeneously refractive unit. Furthermore, although the cambial walls are clearly anisotropic during the period of cell enlargement, *Figure 1*, their anisotropy tends to be obscured after the initiation of secondary wall formation and of lignification.

During the transformation of sapwood into heartwood the walls may absorb more or less "Gerbstoffe" which further alters their solubilities, optical properties, and staining reactions. Similarly, during the seasoning of sapwood, the walls may become saturated with various substances that are contained in the vacuoles of the living cells or are produced by the dying protoplasts. Therefore, critical observations should be made, if possible, upon freshly cut sections of living sapwood.

THE MATURE SECONDARY XYLEM

As will be shown in a subsequent paper of this series, the secondary wall is exceedingly complex, from a morphological point of view. It varies greatly not only in different tissue cells, but also in homologous walls of different plants.

In the case of normal tracheids,[1] *Text figure 1*, the secondary wall consists of three layers:[2] (1) a relatively narrow outer layer (c), (2) a narrower inner layer (e), and (3) an intervening layer (d) of variable thickness. The narrow inner and outer layers are characterized by having their fibrils of cellulose oriented more nearly at right angles to the longer axis of the cell, whereas the intervening layer is characterized by having them arranged either longitudinally or diagonally. The secondary walls project inward and are not in contact with the cambial walls in those parts of the cell where bordered pits are formed, *Text figure 2*. The narrow inner and outer layers of the secondary wall come together in the rim formed about the pit-aperture.

When unstained sections of wood are examined in white light, *Figure 8*, the narrow outer layers of the secondary walls of adjoining tracheids tend to blend with the cambial walls and the intercellular substance, forming an apparently homogeneous refractive layer, i. e., the so-called middle lamella of Dippel and of other botanical writers. That this middle lamella is actually a compound structure may be determined by

[1]Excluding "Rotholz" tracheids and other specialized and peculiar types.
[2]We are not concerned here with the submicroscopic layering which is revealed by swelling the walls and by other drastic treatments.

a careful study of the layering in the bordered pit-pairs (compare *Figure 8* and *Text figure 2*) or by transferring the sections to liquids of varying indexes of refraction.

When unstained transverse sections of wood are examined in polarized light with crossed nicols, the images vary considerably, depending

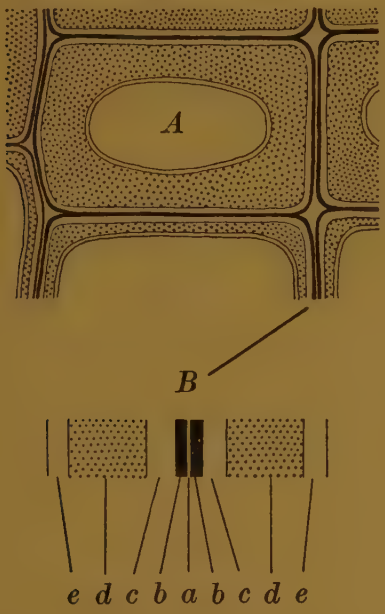

Figure 1

Figure 2

TEXT FIGURE 1. (A) Diagrammatic transverse section of one entire tracheid and of parts of seven others. (B) Section of adjacent walls more highly magnified; (a) truly isotropic intercellular substance, (b) cambial or primary wall, (c) outer layer of secondary wall, (d) central layer of secondary wall, (e) inner layer of secondary wall.

TEXT FIGURE 2. Diagrammatic bordered pit-pair in sectional view, showing pit-membrane, torus, and pit-apertures or openings in the secondary walls. Wall layers as in Text Fig. 1. t = torus or central thicker portion of the pit-membrane. The torus and the pit-membrane are composed of two cambial walls and of intercellular material.

upon a number of fluctuating factors. The narrow inner and outer layers of the secondary wall exhibit double refraction and are brilliant, *Figure 9*, whereas the central layer of the secondary wall is dark or less birefringent.[1] In other words, the phenomena observed between crossed

[1]The conditions tend to be reversed in longitudinal sections.

nicols are closely correlated with the orientation of cellulose micellæ. Where these are arranged parallel to the long axis of a tracheid, a layer appears dark in cross sections; where they are oriented nearly at right angles, a layer is brilliant. The brightness varies at intervening angles.

The closely approximated outer layers of the secondary walls of adjoining cells allow so much light to get by the crossed nicols that they fog or obscure, *Figure 9*, the three tenuous intervening layers, except in extremely thin sections, *Figures 5* and *6*. But in the case of the latter sections, the cambial walls and the intercellular material appear as a single isotropic layer, i. e., Dippel's intercellular substance, the so-called middle lamella of Van Iterson, Ritter, and others. The isotropic aspect of the cambial walls is due largely to the fact that they are so feebly anisotropic in comparison with the brilliant outer layers of the adjoining secondary walls, that they appear dark in contrast to them. Therefore, it is difficult to demonstrate the anisotropy of cambial walls when they are in contact with secondary walls, except under favorable circumstances. In the case of the mature xylem, the best material for this purpose occurs in those cells or portions of cells in which the cambial walls do not thin down excessively during tissue differentiation. Thus, in *Figure 7*, the feebly anisotropic cambial walls are visible between the brilliant outer layers of the secondary walls. By treating thin sections of the mature xylem with 65% phosphoric acid or diluted Schweizer's reagent, there is sufficient swelling so that it is possible to see the cambial walls as an anisotropic entity distinct from the outer layers of the secondary walls.

When woods are prepared for sectioning by the usual procedure of boiling in water and softening in hydrofluoric acid, the staining of sections with ruthenium red or with Haidenhain's haematoxylin produces the general appearance illustrated in *Figure 19*. The cambial walls and the intercellular material react as a unit—i. e., the so-called middle lamella or primary wall of various botanical writers—and stain more intensely in ruthenium red and haematoxylin than do the three layers of the secondary wall which react as another unit. It is possible to differentiate this homogeneously-staining so-called middle lamella into its constituent layers, not only by optical methods but also by chemical methods and differential staining. Thus, when sections of freshly cut wood, or of seasoned wood soaked in cold water, are treated with solvents for removing polyuronides, the cambial walls may be stained without appreciably coloring either the secondary walls or the intercellular material, *Figure 20*. By accurately controlled delignification, followed by treatment in Schweizer's reagent, it is possible to dissolve both the inter-

cellular material and the secondary walls, leaving the cambial walls intact, *Figure 15*. Owing to the fact that they may be unlignified, such minute and delicate structures as tori and pit-membranes may be resolved into their constituent layers by the use of solvents for polyuronides, *Figures 17* and *18*.

As shown by Harlow (13), the residues which remain after treating sections of wood with 72% sulphuric acid and subsequently boiling in 3% sulphuric acid, vary considerably in different species, depending upon the intensity of lignification. In the case of the dicotyledons, the secondary walls of the tracheids and fiber-tracheids frequently dissolve or disintegrate into a finely granular residue, whereas the more intensely lignified walls of the vessels do not, *Figure 14*. In most of the Coniferæ, and in certain of the more heavily lignified dicotyledons, the secondary walls of the tracheary elements swell greatly but do not dissolve or disintegrate. Although the residues of the secondary walls may or may not be present after the action of 72% sulphuric acid, the compact remains of the so-called middle lamella persist. Such "middle lamella" residues always consist of at least three layers, *Figure 21*, and at times may be composed of five layers, *Figure 16*. Five-layered structures occur where the residues of the heavily lignified outer layers of the secondary walls remain closely attached to the residues of the cambial walls and of the intercellular substance. They may be differentiated from the three-layered residues by the structure of the bordered pits (compare (a) in *Figure 16* with *Text figure 2*). If the residues are five-layered, the pits retain their bordered appearance.

Since lignin and pectic compounds are isotropic, the anisotropy of the cambial walls suggests that the cellulose which is present originally persists during tissue differentiation and during the physiological processes of lignification. But what becomes of the polyuronides? Are they replaced by, or transformed into, lignin, or are they merely masked by lignification, which modifies their chemical solubilities, staining reactions, and other properties? Since the so-called middle lamella is intensely lignified, and since the presence of lignin may alter the reactions of the polyuronides, these questions should be attacked by a study of delignified material. It is essential, however, in delignifying wood to use solvents that do not simultaneously remove both lignin and polyuronides. For example, hot sodium sulphite macerates, and removes pectic substances from the cambium and other soft tissues. Thus, the fact that sections of wood are quickly macerated by alternate chlorinations and treatments with hot sodium sulphite does not indicate neces-

sarily that the intercellular layer is composed solely of lignin rather than of a mixture of lignin and polyuronides.

An extensive study of the delignification of wood by standard procedures indicates that delignification and maceration are not necessarily coincident reactions. When sections of various dicotyledons are given alternate treatments with chlorine water and 10% ammonium hydroxide in either aqueous or alcoholic solution at room temperature, until they no longer show traces of the Mäule reaction, *they do not macerate,* although they dissolve completely in 72% sulphuric acid. The delignified sections *may be macerated,* however, by subsequent treatments with standard solvents for polyuronides. In other words, the isotropic intercellular substance of mature wood appears to be composed of two substances, lignin and polyuronides, which may be separated by their differential solubilities.

In delignified sections of wood, the cambial walls react much as they do in freshly cut sections of the cambium. In both types of sections, they persist as a non-cellulose residue after treatment with Schweizer's reagent, *Figure 15*. Furthermore, both types of sections are completely soluble in cuprammonium hydroxide after treatment in solvents of polyuronides. In other words, the cambial walls of the mature wood appear to be composed of a mixture of lignin, cellulose and polyuronides.

If the polyuronides originally present in the cambium persist in the mature xylem, and are more or less masked by lignification, it should be possible to extract substances of a pectic nature from wood. This has been accomplished by Professor Anderson. It should be emphasized in this connection, however, that, if the polyuronides of the so-called middle lamella are of a pectic nature whereas those of the secondary wall are hemicelluloses—as appears to be the case—the yields of the former when computed as percentages of the total dry weight of the wood must of necessity be very low. This is due to the fact that the volume of the cambial walls and intercellular substance is very small in comparison with that of the thick secondary walls. In the cambium and other soft tissues, on the contrary, the intercellular substance and the cambial or primary walls form a high percentage of the total dry weight of the tissue. Therefore, the yields of pectic compounds from a given weight of such tissue is high in comparison with that of mature wood. It is evident accordingly that a transformation of pectic compounds into hemicelluloses and lignin is not essential to account for the fact that soft tissues give high percentages of pectic substances and low yields of hemicelluloses, whereas wood gives high percentages of hemicelluloses and lignin and low yields of pectic compounds.

DISCUSSION

The data recorded in preceding paragraphs indicate that the walls of the cambial initials contain cellulose and are truly anisotropic, and that these walls retain their cellulose and anisotropy during tissue differentiation. Similarly, there is considerable cumulative evidence to indicate that the polyuronides which are present in the walls of the cambial initials and constitute the bulk of the intercellular material, are carried over into the mature wood, and are not entirely replaced by, or transformed into, lignin.

Ritter's (19, 20) arguments for considering that the "middle lamella" is composed largely of "lignin" rather than of pectic compounds are the following: (1) When sections of mature wood are subjected to a standard process for isolating cellulose—i. e., alternate chlorinations and treatments with hot sodium sulphite to remove lignin—the "middle lamella" dissolves, leaving the secondary walls, which are birefringent and are soluble in 72% sulphuric acid. (2) Conversely, when sections are treated with 72% sulphuric acid, the "middle lamella" remains intact, but may be dissolved by subsequent chlorinations and treatments with hot sodium sulphite. (3) When sections are treated with standard solvents of pectic compounds, the "middle lamella" is not dissolved. (4) Ruthenium red is not specific for pectic compounds.

We have shown that delignification and maceration, produced by chlorinations and treatments with dilute alkalis, are not necessarily coincident reactions. Sections of wood may be delignified without dissolving the so-called middle lamella. Such delignified sections may be macerated by the subsequent use of standard solvents for polyuronides. Where sections of wood are macerated by repeated chlorinations and treatments in hot sodium sulphite, the truly isotropic intercellular material dissolves, but the cellulose-containing cambial walls do not. In other words, all of the middle lamella—as defined by Van Iterson, Ritter, and others—does not dissolve when sections are macerated by these standard procedures for removing lignin. Furthermore, we have found that hot sodium sulphite alone is a rapid macerating agent for the cambium and other meristems. Thus, chlorination and hot sodium sulphite remove polyuronides as well as "lignin."

We have shown that the "middle lamella" residues left after treating wood with 72% sulphuric acid always consist of at least three layers and in some cases of five layers. It should be emphasized, in addition, that lignin is not the only substance present in plant tissues that is insoluble in 72% sulphuric acid. Dadswell (8) has shown that much of the "Gerbstoffe" which fills the lumens and saturates the walls of

the xylem cells of *Eucalyptus* and of other genera remains as a residue after standard treatments with 72% sulphuric acid. Our own observations upon sections of a wide range of angiosperms and gymnosperms indicate that, in addition to various types of "Gerbstoffe," coagulated protoplasm and nuclei and the contents of certain types of vacuoles may persist after standard treatments with sulphuric acid. Although the walls of the freshly cut cambium dissolve readily in 72% sulphuric acid, they do not do so after soaking in tannic acid or if they are allowed to absorb certain phenolic substances that are contained in the vacuoles of the living cells. Such facts as these suggest that in the case of wood, the so-called lignin residues may actually consist of a varying mixture of insoluble substances.

The ruthenium red reaction was developed by Mangin (17) during his extensive investigations of the distribution of pectic substances in plant tissues. Although it is not specific for pectic substances, it is extremely useful, when employed with proper precautions, in analytical work. Our investigations of a wide range of organic compounds of known chemical composition indicate that ruthenium red in dilute solutions stains three distinct categories of substances that are of common occurrence in the cambium and its derivative tissues: (1) coagulated protoplasm and nuclei, (2) certain lipoids, and (3) polysaccharides that contain glycuronic or galacturonic acid, e.g., pectic compounds, gums, mucilages, hemicelluloses, oxycellulose, etc. In view of the fact that the first category of substances may be differentiated microscopically and that the second category are removed by preliminary treatments with lipoid solvents, an intense staining of cell walls with ruthenium red is strong presumptive evidence of the presence of polyuronides. Thus, the ruthenium red reaction is extremely useful, not only in studying the distribution of polyuronides in plant tissues, but also in chemical analyses, as a means of visually following the effects of successive steps in the extraction of such substances. We have utilized it effectively in our cooperative investigations with Professor Anderson as a means of modifying chemical techniques for the extraction of pectic compounds and hemicelluloses, and of securing larger yields of these substances from specific tissues.

Ritter's data may be interpreted as demonstrating that the so-called middle lamella is strongly lignified, but they do not provide a reliable basis for concluding that it is composed of lignin rather than of cellulose, polyuronides, and lignin. Our observations, on the contrary, tend to support the views of Schmidt and his co-workers (26, 27), who have argued that lignin occurs in close association with polyuronides.

As stated in our introduction, there is no consensus of opinion concerning the use of such terms as intercellular substance, middle lamella, primary wall, etc. Serious discrepancies in morphological, biophysical, and biochemical investigations have arisen not only owing to differences in definition, but also as a result of inconsistencies in applying specific terms to different tissues and even to the same tissue when different techniques are employed. It is essential to clarify the situation, if possible.

That Dippel and others are not consistent in their use of the terms, *intercellular substance, middle lamella,* and *primary wall,* is indicated by a careful study of their texts and particularly of their illustrations of different tissues, *Table 1.* Thus, in dealing with the secondary xylem, Dippel (10) obviously uses the term *middle lamella* in referring to a five-layered structure which consists of two cambial walls, two layers of secondary thickening, and a layer of intercellular material, *Text figure 1.* His isotropic substance—i. e., Van Iterson's (33) "original or true middle lamella" and the middle lamella or primary wall of various other

TABLE I

COMPARATIVE TERMINOLOGIES

Soft Tissues	Proposed Terminology for SOFT OR WOODY TISSUES (Text figures 1 and 2)	Woody Tissues
	(a)	Intercellular Substance (Dippel)
Intercellular Substance (Dippel) =	MIDDLE LAMELLA or INTERCELLULAR SUBSTANCE (b)	Middle Lamella (Van Iterson and others)
		Primary Wall (Various botanists)
Primary Wall (Dippel) =	CAMBIAL or PRIMARY WALL (c)	
	OUTER LAYER OF SECONDARY WALL (d)	= Primary Wall (Dippel and others)
	CENTRAL LAYER OF SECONDARY WALL (e)	= Secondary Wall (Dippel and others)
	INNER LAYER OF SECONDARY WALL	= Tertiary Wall (Dippel and others)

b+a+b

c+b+a+b+c = Middle Lamella of Dippel and Intercellular Substance of earlier botanists

writers—actually consists of two feebly anisotropic walls and a layer of truly isotropic intercellular material. His primary wall is the strongly isotropic first-formed layer of secondary thickening. On the contrary, in dealing with the unlignified parenchyma of other tissues, Dippel frequently uses the term *primary wall* in referring to layers that are homologues of the cambial walls, and the term *intercellular substance* in designating the truly isotropic intercellular material. It should be emphasized, in this connection, that many of the most serious discrepancies are due, on the one hand, to confounding the cambial walls with the intercellular material, and, on the other hand, to confusing them with the narrow outer layer of the secondary wall.

The question arises, accordingly, as to what changes are advisable in the definition and use of such terms as *middle lamella, intercellular substance,* and *primary wall.* Are they so firmly established in the literature that they should be retained and redefined, or has their varied use led to so much confusion that they should be replaced by new terms?

Our own conclusions, based upon a detailed study of the cambium and its derivatives and upon preliminary investigations of other meristems and their derivatives, are (1) that the term *primary wall* should not be applied to the first-formed layer of secondary thickening but should be used solely in designating the cambial wall and its homologues in other tissues, and (2) that the term *middle lamella* should be used synonymously with *intercellular substance* in referring to the truly isotropic layer of intercellular material. If some term of convenience is required in referring to those complexes of lignified layers which appear more or less homogeneous under certain specific conditions, Van Iterson's term, *compound middle lamella* is available. It should be clearly recognized, in this connection, however, that the compound middle lamella will be five-layered or three-layered, depending upon the specific techniques used in examining the tissue.

Our reasons for advocating these changes in terminology are the following: There are two distinct and fundamentally different categories of cell walls. Meristematic elements and such of their derivatives as retain a potentiality for growth and enlargement have walls which are characterized by their capacity for growth and extension and for undergoing reversible changes, e. g., in thickness. On the contrary, tissue cells which undergo irreversible changes and thus lose their potentiality for growth and enlargement may form a supplementary or *secondary wall* which tends to be more or less conspicuously laminated.[1] The

[1]This differentiation of primary and secondary walls is similar to that used by Balls (6) in his study of the structure of the cotton hair.

term *primary* wall has been used in referring to the walls of meristematic elements, to the walls of their enlarging derivatives, and to the first-formed layer of true secondary thickening in lignified tissues. To continue to apply the term *primary wall* to two entirely different structures must inevitably perpetuate the existing confusion. Therefore, in view of the fact that the cambial wall—and its homologues in other tissues—is a discrete morphological structure which maintains its identity under all conditions of growth and development, it seems advisable to designate it as the *primary wall.* Any terminology which attempts to differentiate successively formed layers of secondary thickening as primary, secondary, and tertiary walls breaks down completely when applied to all types of cells, i. e., to vessel, fibers, sclerenchyma, etc.

The term *middle lamella,* which was used originally as a substitute for *intercellular substance,* has been employed in the case of lignified tissues in referring to five-layered or three-layered structures and in the case of soft unlignified tissues in designating a layer of truly isotropic material. In view of the fact that there has been an increasing tendency to apply the term to a supposedly isotropic layer in lignified tissues, it seems desirable to restrict the term to the truly isotropic *intercellular substance* which separates the primary walls of adjoining cells.

The objection may be raised that the partition membrane is secreted between the halves of the split cell plate, that it originates as a single unit which has a "primary cleavage plane," and therefore that the two adjacent cambial walls and the subsequently formed intercellular material should be designated as the middle lamella or primary wall. The conception of a cell plate which originates from central thickening of spindle fibers and divides to form two protoplasmic membranes, and of a partition wall which is secreted between the halves of the split cell plate and possesses a predetermined plane of cleavage, rests upon entirely inadequate cytological evidence. It has been severely criticized in recent years by Robyns (21) and others and is questioned by most of those who have worked with living cells and are familiar with the physico-chemical properties of living protoplasm. The colloidal properties of the spindle, the cell plate, and first-formed partition membrane are such that they tend to become more or less profoundly modified during fixation and in injured or plasmolyzed living cells. There is no reliable evidence at present to refute Mangin's suggestion that pectic substances are secreted between the newly formed protoplasmic membranes and that mixtures of cellulose and pectic substances are not formed until subsequently.

In the case of cambial initials and of many other cells, a fraction only of the cambial wall originates during cytokinesis. A large proportion of the wall is formed by the growth and extension of its existing surfaces.

Therefore, in view of the fact that each cambial wall is a discrete morphological structure which maintains its identity under all conditions of growth and development, we do not believe that terminology should be governed solely by phenomena which occur during cytokinesis.

SUMMARY AND CONCLUSIONS

1. A detailed study of the cambium indicates that each initial is enclosed within a wall of its own which is separated from the walls of adjoining initials by more or less intercellular material.

2. The cambial wall is composed largely of cellulose and polyuronides, and is truly anisotropic. It is characterized by its capacity for growth and extension and for undergoing reversible changes in thickness. It is also characterized by possessing plasmodesmata which may be uniformly distributed or aggregated in more or less conspicuous primary pit-fields.

3. The amorphous intercellular material, on the contrary, is composed largely, if not entirely, of polyuronides and is truly isotropic. It is characterized by its plasticity which facilitates those movements and adjustments of cells which are such typical features of the actively growing cambium.

4. In other words, the wall of the cambial initial is a discrete morphological structure which maintains its identity under all conditions of growth and development, whereas the intercellular material is passively molded into various forms and possesses few of the attributes of a true membrane.

5. In the case of those derivatives of the cambium which retain their capacity for growth and enlargement and for undergoing reversible changes, the cambial walls are but slightly modified during tissue differentiation, and no supplementary walls are formed.

6. On the contrary, in the case of tissue cells which undergo irreversible changes and form layers of true secondary thickening, the cambial walls and the intercellular layer become thinner and considerably modified in form during the process of cell enlargement. Furthermore, their optical properties, chemical solubilities, and staining reactions are altered or masked by intense lignification.

7. It is possible to demonstrate, however, that the cambial walls retain their anisotropy during and after tissue differentiation, and, by accurately controlled delignification, to unmask the original chemical solubilities and staining reactions of both the cambial walls and the intercellular material. There is, in fact, much cumulative evidence to indicate that the original cellulose and polyuronides are not completely replaced by or transformed into lignin during tissue differentiation.

8. Thus, the putative "isotropic middle lamella" of the mature xylem is not a homogeneous layer, but consists of two lignified anisotropic cambial walls and an intervening, truly isotropic layer of lignified material.

9. Residues of the so-called middle lamella, obtained by the action of 72% sulphuric acid on mature wood, always consists of at least three layers, i. e. the residues of two cambial walls and of the intercellular material.

10. In macerations produced by repeated chlorinations and treatments with hot sodium sulphite, which dissolves both lignin and pectic compounds, a portion only of the so-called middle lamella dissolves, i. e. the truly isotropic intercellular material. The cellulose-containing cambial walls persist and adhere to the layers of secondary thickening.

11. Delignification of the so-called middle lamella and maceration are not necessarily coincident reactions. By carefully controlled chlorinations and treatments with 10% ammonium hydroxide at room temperatures, sections of wood may be delignified without dissolving the so-called middle lamella. Such delignified sections may be macerated, however, by subsequent treatments with standard solvents of pectic substances. In other words, the isotropic intercellular substance of mature wood appears to be composed of two substances, lignin and pectic compounds, which may be separated by their differential solubilities.

12. Serious discrepancies in the use of such terms as *intercellular layer, middle lamella,* and *primary wall* are due not only to differences in the definition of these terms, but also to inconsistencies in applying them to different tissues, and even to the same tissue when different techniques are employed.

13. As a result of our detailed study of the cambium and its derivatives and of our preliminary investigations of other meristems and their derivatives, we suggest (1) that if the term *middle lamella* is to be retained, it should be used synonymously with *intercellular substance* in referring to the truly isotropic layer of intercellular material and (2) that the term *primary wall* should no longer be applied to the first-formed layer of secondary thickening, but should be used solely in designating the cambial wall and its homologues in other tissues.

ACKNOWLEDGMENTS

In conclusion, we wish to express our gratitude to Professor S. J. Record for his kindness in sending us woods of various tropical dicotyledons. We are much indebted to Professor Ernest Anderson and

Doctor H. A. Spoehr for numerous helpful suggestions during the course of our cooperative investigations. We are also indebted to Professor O. L. Sponsler and to Professor E. T. Wherry for various criticisms and suggestions.

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DESCRIPTION OF PLATES

Plate 110

Photomicrographs made with polarized light and crossed nicols. Figs. 3-7 from sections 5 μ in thickness.

Fig. 1. *Pinus Strobus.* Transverse section of the actively growing cambium and its differentiating and fully differentiated derivatives, showing anisotropy of the cambial walls. × 265.

Fig. 2. *Fraxinus americana.* Tangential longitudinal section of the cambium, showing anisotropy of the walls of both ray initials and fusiform initials. × 210.

Fig. 3. *Pinus Strobus.* Tangential longitudinal section of the cambium, showing anisotropic walls of two adjacent fusiform initials and the isotropic intercellular material. The thinner areas of the walls are the so-called primary pit-fields. × 1510.

Fig. 4. *Fraxinus americana.* Tangential longitudinal section of the cambium, showing the anisotropic walls of two adjacent fusiform initials and beaded appearance due to closely approximated primary pit-fields. × 1510.

Fig. 5. *Trochodendron aralioides.* Transverse section of the latewood, showing one entire tracheid and portions of seven adjoining ones. The thick secondary walls are composed of three layers: a narrow, brilliant, outer layer, a brilliant, narrow, inner layer, and a wide intervening dark layer. The brilliant outer layers of adjoining secondary walls are separated by a narrow dark layer, i. e., the so-called middle lamella, which actually consists of two feebly anisotropic cambial walls and a truly isotropic layer of intercellular material (Compare *Text fig. 1*). × 1415.

Fig. 6. *Trochodendron aralioides.* Transverse section of the earlywood, showing one entire tracheid and portions of seven others. Details of structure as in *Fig. 5*, except for the difference in thickness of the central layer of the secondary wall. × 1415.

Fig. 7. *Myodocarpus simplicifolius.* Transverse section of the xylem, showing one entire fiber-tracheid and portions of six adjoining ones. The feebly anisotropic cambial walls are visible between the adjacent outer brilliant layers of the secondary walls. × 1510.

PLATE 111

Fig. 8. *Sequoia sempervirens.* Transverse section of the xylem, unstained and photographed in white light. The inner and outer layers of the secondary wall are more refractive than the wide central layer. The outer layers of adjacent secondary walls blend with the intensely lignified cambial walls and intercellular substance, forming an apparently homogeneous middle lamella which actually consists of five layers. Section of bordered pit at the right. ×1320.

Fig. 9. *The same.* Photographed in polarized light with crossed nicols. In a section of this thickness, 15 μ, the isotropic intercellular substance and feebly anisotropic cambial walls are completely fogged or obscured by the brilliant outer layers of the secondary walls. (Compare *Fig. 5* for section 5 μ in thickness.) × 1320.

Fig. 10. *Fraxinus americana.* Tangential longitudinal section of the phloem, showing but slightly modified cambial walls. Compare *Fig. 11.*) × 800.

Fig. 11. *Fraxinus americana.* Tangential longitudinal section of the cambium, showing walls of ray initials and fusiform initials. × 800.

Fig. 12. *Fraxinus americana.* Tangential longitudinal section of the xylem after standard treatment with 72% sulphuric acid, showing residue of cambial walls which have not thinned down excessively during tissue differentiation. (Compare *Fig. 11.*) × 800.

Fig. 13. *Fraxinus mandshurica.* Tangential longitudinal section of the xylem, showing thick cambial walls between the secondary walls of parenchymatous elements. (Compare *Figs. 11* and *12.*) × 800.

PLATE 112

Fig. 14. *Betula papyrifera.* Transverse section of the xylem after treatment with 72% sulphuric acid. The secondary walls of the fibers have dissolved, whereas the more intensely lignified secondary walls of the vessels have not. × 180.

Fig. 15. *Taxodium distichum.* Transverse section of the xylem after five successive treatments with chlorine water and 10% ammonium hydroxide and extraction with Schweizer's reagent. The intercellular substance and secondary walls have dissolved, leaving the cambial walls only. × 875.

Fig. 16. *Pinus radiata.* Transverse section of the xylem after standard treatment with 72% sulphuric acid, showing five-layered "middle lamella" residue. The five-layered character of the residue may be accurately determined by the structure of the bordered pit at (a). × 945.

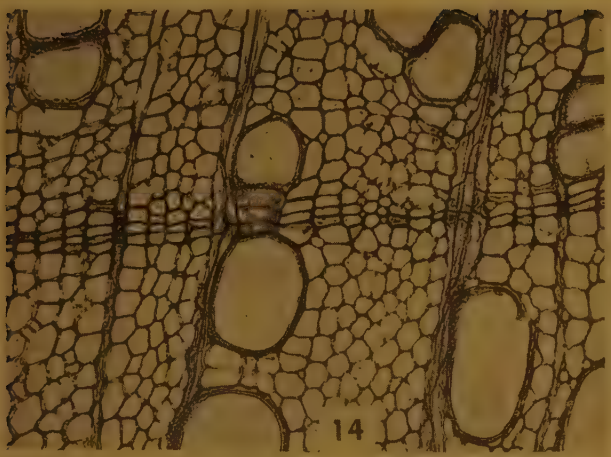
Fig. 17. *Sequoia sempervirens.* Tangential longitudinal section of the xylem, showing bordered pit in sectional view. The torus consists of two thickened areas of the cambial walls and an intervening layer of intercellular material. (Compare *Text fig. 2.*) × 2740.

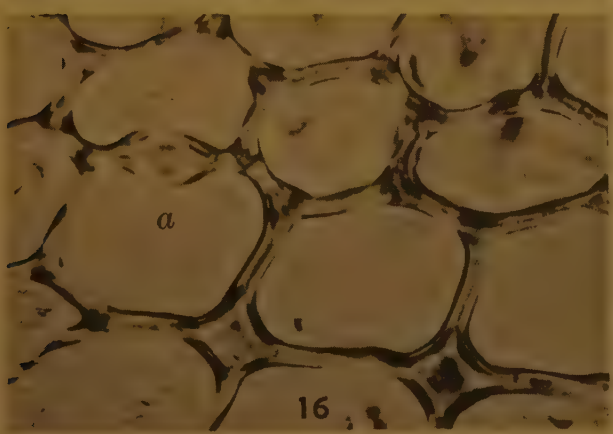
The so-called Middle Lamella

THE HELIOTYPE CORP. BOSTON

The so-called Middle Lamella

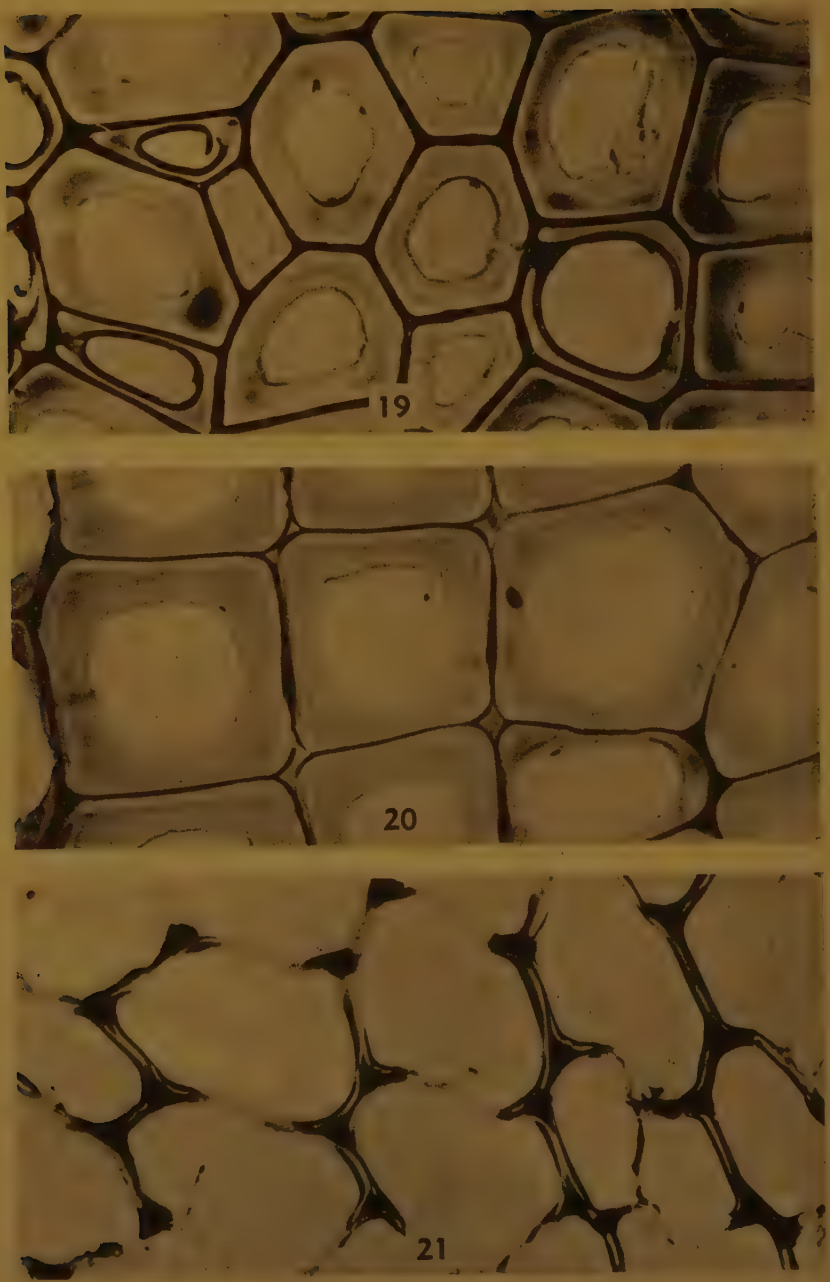
THE HELIOTYPE CORP. BOSTON





The so-called Middle Lamella

THE HELIOTYPE CORP. BOSTON



THE SO-CALLED MIDDLE LAMELLA

THE HELIOTYPE CORP. BOSTON

Fig. 18. *Sequoia sempervirens.* Tangential longitudinal section of the xylem, showing bordered pit in sectional view. The unlignified intercellular material of the pit-membrane has dissolved, leaving the two cambial walls intact. (Compare *Text fig. 2.*) × 2740.

PLATE 113

Fig. 19. *Trochodendron aralioides.* Transverse section of the xylem, stained with Haidenhain's hæmatoxylin and safranin, and showing deeply stained "middle lamella" which consists of two cambial walls and a layer of intercellular material. × 1130.

Fig. 20. *Trochodendron aralioides.* Transverse section of the xylem after repeated extractions with solvents of polyuronides and after staining with ruthenium red. The cambial walls are deeply stained, whereas the secondary walls and the intercellular substance are not. × 1130.

Fig. 21. *Trochodendron aralioides.* Transverse section of the xylem after standard treatment with 72% sulphuric acid and staining with ruthenium red, showing the three-layered residue of the "middle lamella." × 1130.

ARNOLD ARBORETUM, HARVARD UNIVERSITY AND
CARNEGIE INSTITUTION OF WASHINGTON.

A VERIFICATION OF THE OCCURRENCE OF YUCCA WHIPPLEI IN ARIZONA

SUSAN D. MCKELVEY

With plates 114-117

ON APRIL 3, 1858, Professor Newberry, accompanying Lieutenant Joseph C. Ives on his expedition to ascertain the navigability of the Colorado River, collected at the mouth of Diamond Creek, Mohave Co., Arizona, leaves of a *Yucca* which Dr. Torrey in 1860 determined as identical with the species which, discovered by Mr. Arthur Schott near San Pasqual in southern California, he had in 1859 named *Yucca Whipplei*. Except for the Newberry collection, unverified hitherto, the species is known only from California. Doctor Trelease in 1902 expressed doubt as to the correctness of the early record because "the locality is so far from the known range . . ."

Since the Boulder Dam project threatens to flood the Diamond Creek region it was felt important to attempt to verify the Arizona record. On May 5, 1932, with O. E. Hamilton, chauffeur-photographer, and two Indians from the Hualapai Reservation, Charles McGee and his father, the author made a trip to the mouth of Diamond Creek. Starting from Peach Spring a considerable distance was travelled by motor truck, the car following the course of a dry stream and demonstrating considerable agility in climbing boulders; the last part of the trip was made on horseback.

The creek or river received its name according to the Indians from Diamond Peak which is situated at its mouth and which in form is distinctly suggestive of the cut gem; Mr. Charles A. Coolidge of Boston, who, in 1887, with Mr. F. L. Olmsted and Professor Agassiz visited the region, says that the name is derived from the presence of small diamonds in the rock.

Diamond Creek which flows in a general northwesterly direction joins, near its mouth, the canyon through which we had descended, and empties into the southern side of the Colorado below the western end of the Grand Canyon; the elevation at this point is approximately 1500 feet but steep sides lead upward from the canyons to mesas 4000-5000 feet higher.

No plants of the desired *Yucca* were seen until within a short distance of the Colorado but then one was discovered several hundred feet

up the western slope of Diamond Creek, from a distance, in color especially, easily to be mistaken for a plant of *Dasylirion Wheeleri* though in form more symmetrical. Eventually a possible ten plants were located, most overhanging the Colorado, but none unfortunately in flower or in fruit. When the Indians understood what plant was sought they expressed familiarity with it and said that the heart was sweet and excellent eating when buried and roasted under hot coals. They also said that it was to be found considerably further to the west, always along the Colorado, but that this region was accessible only on foot or horseback and three days in from Peach Spring.

The leaves on the plants examined appeared to be unusually long for the species, most about 3 feet in length; the blade tapered from union with base to apex, was more or less four-sided, below distinctly keeled, above marked by a narrow central rib, the surface finely striate but not "watered" as is that on many of the California specimens, in color a pale sage-green, the margins pale yellow, horny, entire and sharp or somewhat finely denticulate, the spine acicular, the tip a dark maroon; the plants were 3 - 4 feet broad, solitary and widely separated.

Still desirous of finding flowers, fruit, or preferably both, and aided by the work of the Civilian Conservation Corps which a month or so before had opened up a crude road to the Colorado at a considerable distance to the west of Diamond Creek, a second trip in search of the plant was made on April 29, 1934. Starting a little east of Valentine the road wound circuitously northwestward over the mesas for about 60 miles, crossing lands of the Public Domain and of the Hualapai Reservation until it arrived at New Water Point; from this promontory one looks across and west to the Lower Granite Gorge of the Colorado and east, across Quartermaster Canyon, towards the west end of the Grand Canyon.

No *Yucca Whipplei* had been seen to the rim's edge but any discouragement felt was dissipated as one descended into the gorge for it was noted at once, again not in flower but with plentiful old and characteristic fruit. Despite exceedingly strong wind photographs were obtained as well as specimens, these now in the Herbarium of the Arnold Arboretum.

As at Diamond Creek the plants were solitary and appeared to die after fruiting; none were caespitose; they grew at a considerable distance from each other and not in great numbers. For the most part the leaves were shorter. One old fruit stalk, here illustrated, was 9 feet tall, the scape 3 feet in length, stout below, 14 inches in circumference just above the swollen base, and tapered upward to the tip; the inflorescence proper

6 feet in length, slender-ovoid, the lower branchlets about 6 inches long, the uppermost 3 - 4 inches, the tip racemose for about 8 inches.

The slopes of the Canyon were searched with field-glasses but no flowers were discovered. The Indian guide felt that, in view of the mild winter, the plants should have been in bloom if flowers were to be produced in the current year. He stated, and it appeared to be the case, that the plant never is found on the mesas above but always below the Canyon rim, descending thence to the base of the gorge. The elevation at New Water Point is approximately 5000 feet, the Colorado some 4000 feet lower.

How far to the east and west along the river *Yucca Whipplei* may be found is not known; the author has never heard of its occurrence on the much-botanized south side of the Grand Canyon proper to the east, nor was it seen to the west in the Boulder Dam region or at the crossing of the Colorado at Searchlight; nor could search or inquiry offer encouragement as to its possible presence on the north side of the Colorado, certainly in so far as the Kaibab Forest region is concerned. The plant would appear to be confined to the southern side of the river and to extend for no great distance, in the southwestern use of the term, either to the east or west of the regions visited. It is unfortunate that this interesting extension of range may eventually be obliterated.

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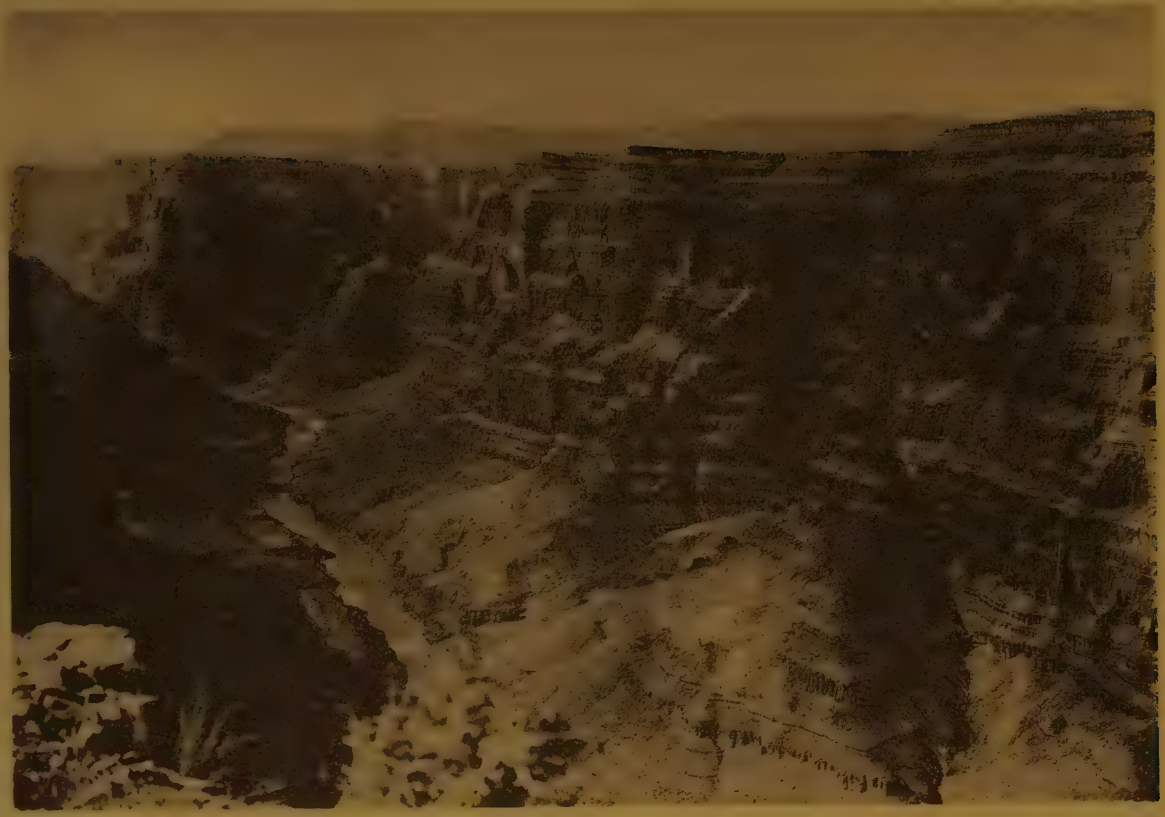
HARVARD UNIVERSITY.

Mature Plant of Yucca Whipplei

Small Plant of Yucca Whipplei growing at New Water Point



View west from New Water Point showing the Lower Granite Gorge of the Colorado

View north showing Diamond Peak. Beyond flows the Colorado

A KARYO-SYSTEMATIC STUDY OF ROBINIA

THOMAS W. WHITAKER

With one text figure

THE GENUS *Robinia* contains about 20 species, and has a strictly North American distribution. Furthermore, it is practically confined to the continental United States; only one species has been recorded from territory outside of this area. An interesting feature about the distribution of this genus is the parallel course it runs east and west of the continent. Thirteen species are found in the Appalachian Mountains from Pennsylvania southward to Georgia and Alabama, and five species are found in the Rocky Mountains from Colorado to as far south as the Mexican border (Rydberg, 1924).

As one of the steps necessary in supplying a biological background for a systematic study of the genus, a karyological investigation has been undertaken of the species of *Robinia* in the collections of the Arnold Arboretum. Although this collection is by no means complete, it contains representatives of each series of the genus, and from this point of view the species examined furnish a general survey of the karyological conditions in *Robinia*. A brief report of the karyological observations and comments on their systematic significance follow.

OBSERVATIONS

Robinia is decidedly not ideal material for karyological studies. The chromosomes are small, and in aceto-carmine smears the differentiation between chromatin and cytoplasm is not particularly sharp. Heating does not alleviate this condition as it does with some material. The chromosome counts were secured from aceto-carmine, and in some cases permanent smears. In Table I the chromosome number and percentage of pollen sterility are recorded for the species that were investigated.

Ser. PSEUDOACACIAE and NEO-MEXICANAE

Tschechow (1930) has published a figure (from mitosis in a root-tip cell) in which *Robinia Pseudoacacia* is shown to have 22 chromosomes. Kreuter (1930) has found 10 chromosomes at meiosis in this species. The present writer did not have material available for study, but from indirect evidence, one is forced to the conclusion that there must be 10 pairs of chromosomes in this species. This conclusion is based on the observations of meiosis in spontaneous hybrids where *R. Pseudoacacia*

was reputedly one of the parents; i. e. *R. Holdtii, R. Slavinii, R. Margaretta.* Since the other supposed parent in most cases has 10 pairs of chromosomes, with normal pairing taking place, the evidence favors the view of Kreuter that *R. Pseudoacacia* has 10 pairs of chromosomes.

TABLE I

		Species	Chromosome number (n)	% of pollen sterility
I.	PSEUDOACACIAE	R. Pseudoacacia L.	*10	25
		R. Holdtii Beissn. (R. Pseudoacacia × R. luxurians)	10	16
		R. fertilis Ashe	10	19
		R. Kelseyi Hutchins.	10	10
		R. hispida L.	15	88
II.	HISPIDAE	R. Boyntonii Ashe	15	72
		R. Slavinii Rehd. (R. Kelseyi × R. Pseudoacacia)	10	48
		R. Margaretta Ashe (R. hispida × R. Pseudoacacia)	10	30
III.	NEO-MEXICANAE	R. luxurians Schneid.	10	25
		R. viscosa Vent.	10	45
IV.	VISCOSAE	R. Hartwigii Koehne	10	10

*From Kreuter (1930)

Robinia Holdtii (*R. Pseudoacacia* × *R. luxurians*) has 10 pairs of chromosomes (Fig. 1). Pairing seems to be normal; the percentage of good pollen is slightly higher than that produced by either parent. Aside from its morphological characteristics, which are intermediate between the parent species, it has few of the attributes of a hybrid.

The only western species of *Robinia* studied, *R. luxurians* has 10 pairs of chromosomes (Fig. 2). Karyologically, it is similar to the diploid eastern species. The plants of *R. luxurians* were labeled as *R. neo-mexicana*. This is undoubtedly an error. As Sargent (1921) and, later, Rehder (1927) have pointed out, *R. neo-mexicana* has probably never been brought under cultivation, and would not be hardy if it were.

Ser. HISPIDAE

In the Hispidae, *Robinia fertilis* and *R. Kelseyi* are apparently two of the basic diploid species (Fig. 3). Each species has 10 pairs of chromosomes, meiosis is regular in both species. The percentage of good pollen is relatively high and an abundance of pods is developed.

Meiosis in *Robinia hispida* and *R. Boyntonii* is very irregular (Figs. 4 & 5). This is to be expected as both are triploids. What appear to be

multivalent associations and univalents have been found at meiosis in both species. The low percentage of good pollen is a further indication that meiosis is irregular. Biologically, all of the plants of *R. hispida* in cultivation must represent a clon, since this species very infrequently produces seed pods, and since it is propagated exclusively by vegetative means. From the fact that tetraploids have thus far never been found

FIGURE 1. *Robinia Holdtii,* 10 chromosomes. FIG. 2. *R. luxurians,* 10 chromosomes. FIG. 3. *R. Kelseyi,* 10 chromosomes. FIG. 4. *R. hispida,* 10 chromosomes. FIG. 5. *R. Boyntonii,* 15 chromosomes, x and y = trivalents, z = univalent. FIG. 6. *R. Hartwigii,* 10 chromosomes. All drawings were made from first metaphase plates. Magnification: Figures 1, 2 and 4 × 2100, 3, 5 and 6 × 2500.

in *Robinia,* presumably the triploids have originated from one of the diploid species, either from an unreduced egg cell or from the fertilization of a haploid egg by a diploid pollen grain (Darlington, 1932). It seems unnecessary to assume, as Kreuter (1930) has done, that *R. hispida* is a hybrid.

Taxonomically *Robinia hispida* and *R. Boyntonii* are more closely allied to *R. fertilis* than they are to other members of the Hispidae. It is very likely that these triploid species may have originated from *R. fertilis*. The case for *R. hispida* in this respect is rather good. In many of its characters *R. hispida* bears a close resemblance to *R. fertilis*.

A spontaneous hybrid between *Robinia Kelseyi* and *R. Pseudoacacia*

has recently occurred under cultivation (Rehder, 1921). This hybrid, *R. Slavinii*, has 10 pairs of chromosomes. The pollen fertility is fairly high, and it sets a moderate crop of seed pods. Pairing seems to be normal. No meiotic irregularities were observed.

Robinia Margaretta is a reputed hybrid between *R. hispida* and *R. Pseudoacacia*. It has many of the characteristics of *R. Pseudoacacia*, and it is quite likely that the latter species may have been one of the parents. It is doubtful whether *R. hispida* could possibly have been the other parent because of its triploid nature. On the other hand, it is quite probable that *R. fertilis* may have been one of the parents. In *R. Margaretta* meiosis was regular. Pollen sterility was as high as 30%, but the plants fruited freely.

Ser. VISCOSAE

Meiosis in *Robinia viscosa* seems to be regular, although there is considerable pollen sterility. This species sets seeds very sparingly. Professor Rehder of the Arnold Arboretum has informed me that in some cases, trees of this species do not set any seed, indicating that in such instances pollen sterility must be much greater or that possibly the plants are self-sterile.

The two species included under the Viscosae (*R. viscosa* and *R. Hartwigii*) are very closely related. Karyologically they are similar (Fig. 6). Of the two, the percentage of good pollen is much larger in *R. Hartwigii*. This probably accounts for the fact that it sets seed in greater abundance.

DISCUSSION

The occurrence of a large number of fertile spontaneous hybrids between the various species of *Robinia* is understandable in the light of the karyological situation shown to exist in the genus. Since a majority of the species are diploids and perfect pairing exists between the hybrids investigated, most of them should hybridize readily whenever opportunity is afforded. Another point of some interest, in this connection, is that the diploid species occur in the Appalachian and on both sides of the continent and apparently hybridize quite easily. *Robinia Holdtii*, a reputed spontaneous hybrid between *R. Pseudoacacia* and *R. luxurians*, may be cited as an example. From the literature it is evident that several cases of this cross have occurred.

Kreuter (1930) and Tschechow (1930) have made extensive karyological investigations of the Tribe Galegeae. Basic numbers of 8, 10, 15, and 24 have been found. The basic number seems to be relatively constant within the genus in this tribe. There is no indication of a karyological relationship between *Robinia* and other members of the

Galegeae. *Amorpha* has a basic number of 10, but the chromosome morphology is distinctly different from that of *Robinia*.

Robinia is one of those genera in which polyploids and hybrids, even though they may be sterile, are factors to be reckoned with in speciation because of the fact that these forms are propagated very readily and rapidly by vegetative means, and are thus able to maintain themselves.

SUMMARY

The basic chromosome number in *Robinia* is 10. *Robinia hispida* and *R. Boyntonii* are triploids. These species are maintained by vegetative means. The chromosomes in all of the hybrids exhibited complete compatibility. This is true of the hybrids between the eastern and western species of the genus, which have been separated by considerable periods of geologic time.

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A CULTURE CHAMBER FOR THE STUDY OF MYCORRHIZAE

A. B. HATCH

With two text figures and plate 118

THE EXACT NATURE of mycotrophic relationships still remains unknown. A first essential of investigation in this field is the development of suitable experimental methods. Among these an outstanding requirement is that of establishing and maintaining pure cultures. The usual apparatus for this purpose is cotton stoppered flasks but the physical environments in these are optimal for neither host nor fungus and extraneous factors that affect the accuracy of results are not eliminated. A culture chamber that meets these requirements has been developed by the writer and is described below.

Factors which affect unfavorably the accuracy of experiments in the apparatus commonly employed include: (1) excessive humidities which promote aërial growth of fungi which in nature are confined to roots only (Melin, 1925; Masui, 1927; Rayner, 1925, 1930; McArdle, 1932; Hatch and Hatch, 1933), (2) increased partial pressures of carbon dioxide in inoculated cultures produce corresponding increases in plant growth but in a manner wholly unrelated to mycotrophy, (3) accumulation of products (in some cases toxic) of fungal metabolism and of unabsorbed ions in substrates that cannot be changed (Melin, 1925), (4) saturated substrates—when fine quartz sand is employed (Rayner, 1930; McArdle, 1932), (5) low radiation intensities resulting in low rates of carbohydrate synthesis.

It is generally believed that if mycorrhizae are beneficial, they must be *accessory* mechanisms only, and by most investigators on this subject they are thought to be concerned with acquisition of nitrogen from infertile substrates. In the closely allied field of nitrogen-fixing, bacterial root-nodules it is known that these accessory mechanisms are called forth under internal conditions of wide carbohydrate/nitrogen ratio only (Fred and Wilson, 1934). The necessity of maintaining rapid rates of carbohydrate synthesis by increasing partial pressures of CO_2, by high radiation intensities, or by both, is evident.

Finally, to be conclusive the data should be quantitative and this involves the growing of large numbers of plants—a task of large proportions in ordinary chambers (McArdle, 1932).

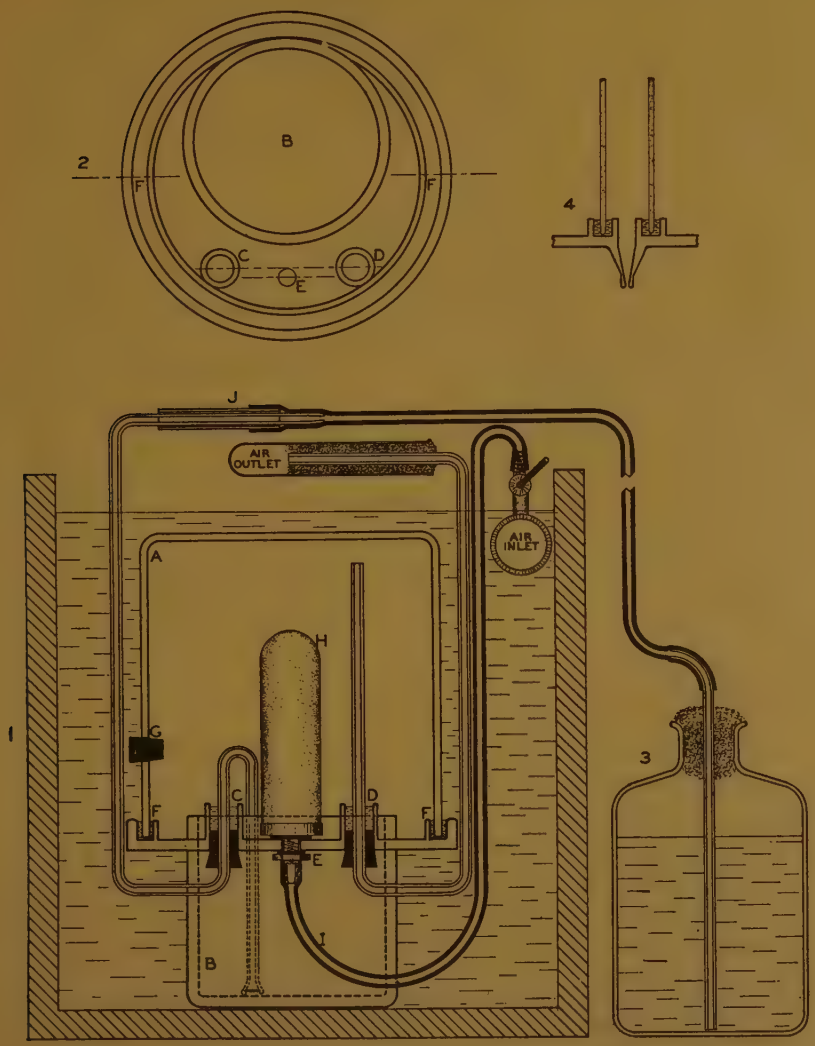

FIGURE 1. Pure culture chamber with 10 × 10⅛ inch bell jar. 1. Schematic drawing of intact chamber in water bath. 2. Plan of porcelain base. 3. Nutrient flask. 4. Structure of alternative base for open-end filter. (Drawings by Robert Ward and the writer.)

To avoid these inaccuracies an apparatus has been developed which facilitates the following: (1) continuous aëration (control of gas composition and moisture content), (2) periodic flooding and aërating of substrate, (3) frequent changes of nutrient or water, (4) exposure to direct solar or artificial radiations of the highest intensities, (5) temperature control, by means of a constant temperature water bath, and (6) indefinite freedom from contamination.

The plant chamber of this apparatus consists of a glazed clay base (my early models had copper bases—see plate 119) through which are inserted all connections and over which is cemented a Pyrex cylinder jar (Fig. 1,[1.A]). The base possesses a substrate well B and a circular platform through which are three openings C, D, and E. Openings C and D are identical, having inside diameters of approximately 2 cm. and heights of 4 to 5 cm. Through these openings heavy-walled pyrex tubes are inserted; one (through C), for changing nutrients, extends to the bottom of the substrate well; the other (through D), for air escape, extends within the chamber to a position near the top of the bell jar opposite the air inlet filter H (in the figure shown in a vertical position). Opening E is for inserting the air filter H, and may be of two types: a plain hole through which a Berkefeld, grade V, water filter is sealed with rubber washers, as shown in the main drawing; or a trough is built around the filter opening and an open base filter is cemented into it during sterilization (Fig. 1,[4]). (The open base filter and suitable chamber base are much less expensive.)

The circular "platform" possesses a trough F around its margin, into which the cylinder jar is cemented. As indicated in Fig. 1, [2,B], the substrate-well is off-center to give space for the three openings C, D, and E. In existing samples of the clay base chamber the glaze has not been wholly satisfactory; accordingly, a pyrex cylinder jar of small size (6 × 6 inches) has been wedged inside of the well to serve as the actual substrate container (see plate 118, which shows this jar in the metal base chamber).

The upper half of the chamber, as indicated, is an inverted pyrex cylinder jar with a 17 mm. opening G through its wall for inoculating and for introducing germinating seeds (approximately 75 mm. above the bottom rim).

The position of the nutrient changing, and air outlet tubes (extending through C and D) on the outside of the chamber is determined by convenience and the method used in maintaining the chamber at a constant temperature. Their positions in Fig. 1,[1] are adapted for complete immersion of the chamber in water.

Sterilization of the chambers may be by steam or by hot air, each of which involves separate consideration.

With steam sterilization, either a Berkefeld filter with rubber seals or the open ended type may be employed, and also rubber stoppers for holding tubes C and D in place as shown in Fig. 1,[1]. Cotton is placed in the inoculation opening of the glass jar and over the outside ends of the tubes through C and D. The base, with sand substrate, and the cylinder jar are then sterilized separately for three hours at one atmosphere; the pressure is allowed to escape quickly; DeKotinsky cement, which has been previously stretched to a suitable thinness, is placed in the spaces above the rubber stoppers in C and D and completely around the trough E, into which the glass jar fits, and also in the filter trough (Fig. 1,[4]) when the open-base filter is used. The intact chamber is then ready for immediate resterilization for 25-45 minutes. Such heating periods are sufficient for killing any organisms which enter during these manipulations and yet are not so long that the strength of the cement is destroyed. A perfect seal is obtained during this final sterilization and by ordinary careful handling the chamber may be kept for months or perhaps years without danger of contamination. Since DeKotinsky cement is slightly soluble in water, all surfaces that come in contact with water in the constant temperature bath should be protected, preferably with picein.

With hot air sterilization, rubber connections must be replaced by cork or other material. The Berkefeld filter is also awkward in this method and the open-base filter (Fig. 1,[4]) must replace it. An advantage of hot air sterilization is that picein cement, which is less expensive than DeKotinsky and also insoluble in water, may be employed. In steam sterilization picein is not suitable, since its specific gravity is less than water and condensing steam prevents the sealing of joints. If chambers of the larger sizes, for agricultural plants, are used (30 $\times$ 14 inches) hot air is most suitable, unless large soil sterilizers are available.

Surface sterilized seed and fungal cultures are inserted through the inoculation opening G while the chamber is in a transfer room. This opening is then sealed with a rubber stopper and picein cement or with the latter alone.

Aëration of the chamber is accomplished preferably by air pressure, but precautions should be taken that such air is free of oil and other impurities and that a proper humidity is maintained (see Shelford, 1925, for suitable equipment). Rates of air passage up to several liters per minute are obtained by Berkefeld 5 $\times$ 15 cm. V filters with pressures of 3-5 cm. of mercury. The open-base filters are less porous and

greater pressures are required for comparable air passage. A rubber tube I should be cemented to the base of the filter-opening before immersion.

The nutrient reservoir consists of a 4-liter, or larger, pyrex or Jena glass bottle with a cotton stopper through which is inserted a glass tube (Fig. 1,[3]). Heavy walled rubber tubing connected to this glass tube extends over a 12 mm. tube of 10 cm. length (Fig. 1,[I,J]). After the culture flask and contained nutrient or water are sterilized, this nutrient changing tube and the tube passing through C are thoroughly flamed and brought together so that the smaller tube extends a few centimeters into the larger one of the nutrient flask (J). After cooling to a point where the rubber will not be injured, they are firmly connected. Except for the latter mode of connecting the nutrient supply to the culture chamber, this siphon tube method of changing nutrients in pure culture was developed by Dr. K. D. Doak at the University of Pennsylvania, only an abstract of whose work is now available (Doak, 1934). In its present form it has been regularly employed by Dr. Doak as well as by the writer for several years without a single contamination being traced to its use.

To flood the substrate the siphon is started by cupping one's hand over the cotton stopper of the nutrient flask and blowing. Subsequent raising and lowering of the nutrient flask floods and drains the substrate. The nutrient supply flask may be disconnected (at J) with entire safety and replaced by a fresh nutrient or water supply at any convenient intervals. With exposure to direct solar radiation the rubber tubing should be replaced every few months.

In early experiments air cooling of the chambers during exposure to direct solar radiation proved to be inadequate. The subsequent combination of air cooling and water cooling (of the substrate well only), although fairly effective, was difficult to handle and air temperatures varied. Finally, complete or partial immersions of the chambers in an approximately constant temperature water tank proved to be entirely satisfactory (Fig. 1,[1]). By this method high radiation intensities, both artificial and solar, are usable. The most exacting requirements of temperature control are also possible.

Standard, heavy walled, pyrex cylinder-jars are available in sizes ranging from 6 × 6 in. up to 12 × 24 in., with many intergradations. Agricultural plants of comparatively large statures (potatoes, tomatoes, grains, etc.) may therefore be grown to maturity in chambers of this design under pure culture conditions and in optimum environments.

The chamber has the disadvantage that roots may not be observed during the course of the experiment. An all glass chamber of the type shown in Fig. 2,D, possessing a flattened substrate tube, has been con-

structed to supplement the lack of this feature in the larger chamber. These chambers are made of Florence flasks of any desirable size. By starting plants in them simultaneously with those in the large chamber, and under the same nutrient conditions, the probable course of development of mycorrhizae in the larger chambers may be predicted. This chamber is also immersed in the water bath. Although air change is not

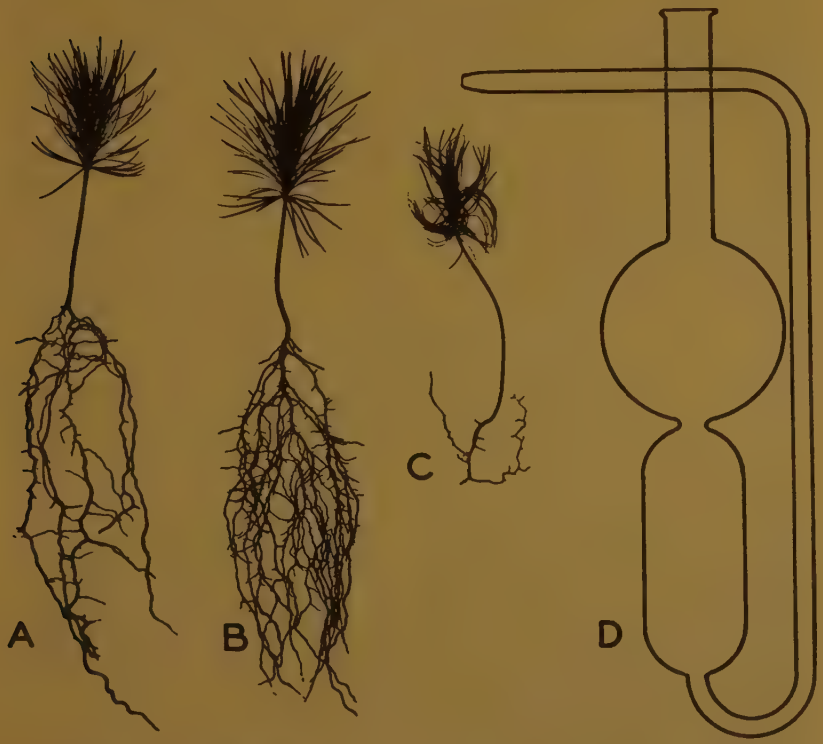

FIGURE 2. Appearance of average seedlings of *Pinus Strobus* grown in sand culture: (A) out of doors (age 3 months), (B) in aërated, nutrient changed pure culture chambers with direct solar radiation and air cooling (age 3 months, February to May 1933) and (C) in Erlenmeyer flasks for 6 months with indirect radiation (Hatch and Hatch 1933). (D) Outline of supplementary culture chamber for observation of roots during course of experiment. Sand substrate fills the flattened tube below the constriction. Glass wool placed in the bottom prevents substrate from moving into nutrient changing tube.

continuous the siphoning of nutrients in and out facilitates a material improvement in the aërial environment over ordinary enclosed flasks.[1]

The types of tree seedlings (*Pinus Strobus* L., 3½ months old) that may be grown in the large chambers are shown in Fig. 2,B. They are quite comparable in size, root shoot ratio, root development, and succulence to those grown in open cultures under direct solar radiation out of doors (Fig. 2,A). An average seedling 6 months old grown in Erlenmeyer flasks is shown in Fig. 2,C.

Development of this apparatus was commenced during the writer's period of study with Professor E. Melin in the mycological laboratories of the Royal Forest Academy, Stockholm, Sweden, in 1930 as Fellow of the American Scandinavian Foundation. The work was continued with the United States Forest Service at the Boyce-Thompson Institute for Plant Research and was finally completed at Harvard University, where the greater part of the work was done. The writer is grateful for the facilities and support of these institutions and to their staffs for advice.

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[1]Both chambers complete with all accessories (cement, tubes, stoppers, filters, etc.) are supplied by MacAlaster-Bicknell Co., Cambridge, Mass. Bases for the 10-inch-bell jars are in stock; all other sizes are made to order.

Seedlings of Pinus Strobus Grown in the Culture Chamber

EXPLANATION OF PLATE 118

Seedlings of *Pinus Strobus* L. grown in aërated, nutrient-changed, air cooled pure culture chamber (metal base type) with full solar radiation (February–May 1933), 3½ months old. × 7/12. Bell jar removed for photograph.

Laboratory of Plant Pathology, Arnold Arboretum,
The Harvard Forest, and the Department of Biology,
Harvard University.

THE ARNOLD ARBORETUM DURING THE FISCAL YEAR ENDED JUNE 30, 1934

THE WINTER OF 1933-34 was the worst ever experienced in the Arboretum. Beginning as early as December 29th, 1933 the thermometer went as low as 17 below zero. The maximum that day was 4 below. The latter part of January, the thermometer was 2 below with no snow on the ground and heavy winds. From February 7th to 10th the temperature varied from 2 below to 18 below. Practically no snow fell until February first.

These variable conditions caused untold injuries to trees and shrubs, killing flower buds and some plants to the grounds. From early spring to June, considerable time was spent in pruning out dead wood and cutting plants to the ground.

Four hundred and ninety-nine plants were added to the Arboretum collections. Two hundred and ninety-one plants were transferred from the Arboretum nursery to South Street Nursery.

During the year, 1712 packages of seed were sent out, 616 in United States and 1096 to 21 foreign countries, 2358 plants and 422 varieties of scions and cuttings. There were received from U. S. and other countries 1105 packages of seed, 1286 plants and 35 cuttings and scions. — L. V. S.

Pathological Laboratory.—The Arboretum's research laboratory in Plant Pathology submits its report for 1933-4, dealing in order with its herbarium, extension services and investigative activities.

The herbarium is essentially restricted to reference collections used in the study of diseases of trees and shrubs. These illustrate symptoms and effects of diseases, causal organisms, and injuries that result from unfavorable physical and chemical environmental factors. Much material has been added during the year. Some specimens have come from correspondents asking for diagnoses, some from other herbaria by way of gifts or exchanges, and many have been collected by members of the staff. Besides exceptionally important local contributions, valuable accessions have come from Japan, Leningrad, Jamaica, the Canal Zone and the Republic of Panama. Attention should again be called to the fact that adequate space for the pathological herbarium has never been provided, and that such as there is has been completely outgrown. Indeed, more than a year ago it was necessary to store elsewhere with crippling effect an entire section involving several thousand numbers.

Use of the extension services afforded by the laboratory continues to show a steady expansion. Inquiries on pathological problems, usually accompanied by specimens, are received from private individuals, nurserymen, arborists, city and town tree wardens, foresters, landscape architects, etc. Such contacts occasionally lead to co-operative undertakings. At the present time experimentation is being carried out by joint arrangement with a few estate owners, two nurseries, a garden club and a state experiment station. On account of well-founded and widespread fears that the Dutch elm disease might spread northward from southern Connecticut, where it is now known to occur, an exceptionally large proportion of inquiries this year have related to elm diseases. From the time of the first report of the discovery in 1930 of the Dutch elm disease in America the Arboretum made preparations to assist in combating it. The very earliest cases were examined in this connection by the head of the department and attention was immediately given to the study of elm diseases, and to acquainting the public in New England with the nature and the seriousness of the disease. Thus a free, voluntary service has been provided apart from but in full sympathy with the aims and efforts of the Federal Bureau of Plant Industry whose laboratory is located at Morristown, New Jersey. In the matter of publicity important work is being done by the Massachusetts Forest and Park Association, an organization with which the Arboretum is cooperating in meeting the new menace to our elms.

Turning to our research activities mention should be made of certain pieces of sustained investigation that have now found expression in printed papers. Dr. John Ehrlich's pioneer studies on the beech disease caused by a *Nectria* following attacks of an introduced bark insect have been issued jointly by the Arnold Arboretum and the Canadian Research Council, by the former as Contribution No. VII and by the latter in a special number of the Canadian Journal of Research. The first part of Dr. Ivan H. Crowell's studies on *Gymnosporangium* appeared in the July (1934) issue of the Journal of the Arnold Arboretum under the title "The Hosts, Life History and control of the Cedar-Apple Rust Fungus Gymnosporangium Juniperi-virginianae Schw." This fungus long known as a parasite alternating between certain orchard apples and red cedars, and recognized as the cause of a destructive disease of the orchard apples and a pest on the red cedars was studied by Dr. Crowell in relation to all known species of apples and a large number of species of *Juniperus*, and to its control by methods other than eradication of red cedars. As a result of an exhaustive series of inoculations it was discovered that all American species of apples are susceptible and all of

Eurasian origin, with the exception of two highly resistant forms, are immune. Similar data were obtained for the red cedar group. Notably, tests of certain sulphur fungicides point the way to successful control without having recourse to the elimination of either host. Professor J. H. Faull has added another chapter to our knowledge of a group of rusts that alternate between firs and ferns—a study of the biology in general of these rusts and completed data on the life histories of several American species.

As indicated above comprehensive studies are now in progress on elm diseases. Part of the field work on these is being done in connection with an auxiliary laboratory opened up on Long Island through the enterprise of Mrs. Harold I. Pratt and the generous support of friends of the Arboretum. Other topics under investigation include various diseases of conifers, the physiology of the mycorrhizae and pseudo-mycorrhizae of pines, rust diseases of the hawthorns and certain other pomaceous hosts, a physiological disease of apples, and a monographic study of *Uredinopsis*.—J. H. F.

Cytogenetic Laboratory.—The work in cytology during the past year has included studies on chromosome structure and the mechanism of meiosis. The examination of Tradescantia chromosomes, after being subjected to various temperatures, and treated with X-Rays, has thrown considerable light on the internal structure of chromosomes, their method of pairing at meiosis, and the factors involved in cell division. The effect of environmental factors on chromosome pairing at meiosis may be an important factor in genetic variation and evolution.

The cytological analysis of taxonomic groups of plants has been continued, especially in the gymnosperms. With the co-operation of Dr. Beal of the University of Chicago, it has been possible to obtain chromosome counts in the cycads. This work, with the analysis of conifer chromosomes completed last year, permits a comparison of the more important groups of gymnosperms. Dr. Whitaker has found an unusual and characteristic chromosome number in a number of rather distantly related monocotelydons. A number of leguminous plants have been examined during the past summer.

Other lines of cytological work in progress include studies on the mechanism of development and differentiation, parthenogenesis, and self-sterility.

The breeding work was rather limited owing to the effects of the severe winter. Some of the hybrids between species of ornamental shrubs should flower in another year.—K. S.

The Herbarium.—During the past fiscal year 16923 specimens have been added to the herbarium bringing the total number up to 391803.

Of these accessions approximately 800 came from the United States and Canada, 825 from Central and South America inclusive of Mexico, 650 from Europe and western Asia, 6000 from China, 600 from Formosa and Japan, 670 from India, 3000 from Sumatra and Borneo, 250 from Australia and Micronesia and 500 from Africa.

Among the more important collections received during the year may be mentioned: 783 specimens from Paraguay collected by Pedro Jorgensen, 790 specimens from Honduras, including duplicates, collected by J. B. Edwards; 327 Brazilian specimens collected by B. A. Krukoff; about 600 Mediterranean plants collected by J. Bornmueller with many duplicates; a collection of 260 specimens of *Tilia* issued by J. Wagner; about 2400 specimens including duplicates of Hainan plants from the Lingnan University; about 1200 specimens including duplicates of Kwangsi plants from the University of Nanking; 600 specimens of Anwhei plants from Wuhan University; about 700 specimens of Szechuan plants from the Science Society of China; about 700 specimens of Yunnan plants collected by J. F. Rock from the University of California; about 1270 specimens from Sierra Leone collected by W. N. Thomas; 425 specimens from South Africa collected by Ecklon and Zeyher; about 2500 specimens from Borneo collected by J. & M. S. Clemens.

To the fruit collection 169 specimens were added bringing the total number up to 7984.

Additions of 815 numbers were made to the wood collection bringing the number up to 3631.

The collection of negatives of types and critical specimens amounts now to 2744 negatives; 220 having been added during the year.

On loan for study outside the Arboretum herbarium 312 specimens were sent to 19 institutions and individuals in this country, in Europe and Asia.

There have been distributed 20140 specimens to 33 institutions in the United States, Canada, Europe, Asia, Africa and Australia.

Botanical exploration by members of the staff or by expeditions partly financed by the Arnold Arboretum has been carried on in America and in Eastern Asia. Dr. H. M. Raup studied during the summer of 1933 the flora at and near the Harvard Forest at Petersham and collected herbarium material. Mrs. Susan Delano McKelvey travelled in the spring of 1934 in New Mexico, Arizona, Nevada, Utah and Colorado, collecting about 1000 specimens with many duplicates; of these 135

numbers represented *Yucca* (dry material, material in formaldehyde, moths and photographs), and 25 numbers *Agave*. The desert because of the drought was almost devoid of bloom, only at the higher elevations were conditions more normal. Mr. E. J. Palmer collected in June 1934 in the southern states paying particular attention to *Crataegus* and studied Beadle's and Ashe's types of this genus in the National Herbarium and in the herbarium of the University of North Carolina. Mr. C. H. Mueller started in the beginning of May 1934 on a collecting tour to northern Mexico for the Arnold Arboretum with the support of the University of Texas.

In China botanical expeditions by three institutions had the financial support of the Arnold Arboretum during 1933. An expedition under the direction of Dr. A. N. Steward from the University of Nanking collected in the province of Kwangsi. By the Lingnan University in Canton three expeditions under the direction of Dr. F. P. Metcalf went to the provinces of Kwangsi, Hunan and to the island of Hainan. An expedition from the Fan Memorial Institute of Biology at Peiping under the direction of Dr. H. H. Hu collected in western China.—A. R.

The Library.—During the past year there have been added to the Library 571 volumes, 400 pamphlets and 346 photographs, making a total of 41,490 bound volumes, 10,485 pamphlets and 17,241 photographs. Many of the additions have been acquired by gift, among them "The Stapelieae" from the author, Alain White; Thomas Horsfield's "Experimental Dissertation on the Rhus vernix, Rhus radicans and Rhus glabrum," 1798, from C. C. Deam; Zhukovsky's "La Turquie Agricole," and "Rastenievodstvo SSSR," from the Institute of Plant Industry at Leningrad; "Report of the Second Norwegian Arctic Expedition in the 'Fram,'" 1898-1902, from the Universitetets Farmasøitiske Institutt, Oslo; and "Letters of Asa Gray," from Katharine P. Loring; together with a large number of pamphlets from Japan, China, Sweden, Germany and Russia. A photostat copy of "Versuch einer Neuen Lehrart die Pflanzen nach Zwei Methoden zugleich," by F. K. Medikus, 1787, was presented by the Herbarium.

Fifteen periodicals, chiefly from Russia, China and Central Europe, have been added during the year, while a few periodicals previously received, but taken in other departments of the University or in neighboring libraries, have been discontinued to avoid unnecessary duplication. Two sets of periodicals, "Gummi-zeitung," volumes xxii-xlvii, and "Gummi- und Asbest-zeitung," volumes vii-xxxii, were transferred to the Baker Library of Harvard University School of Business Administration.

Cards filed during the year include 836 in the card catalogue of books in the Library, 458 in the catalogue of photographs, 4,918 in the "Card-Index of New Genera, Species and Varieties Published by the Gray Herbarium," and 3,411 in the manuscript of "Index of Illustrations and of New Genera, Species and Varieties of Ligneous Plants Published since 1915," prepared at the Arboretum, bringing the total number of the latter to 101,050. For supplements to the author and subject "Catalogue of the Library" 1,300 slips have been filed.

There have gone out as inter-library loans to universities and scientific institutions 255 volumes, and 26 volumes have been borrowed.

Volumes bound number 325, and many smaller works have been put into pamphlet binders.

The "Journal of the Arnold Arboretum" and "Arnold Arboretum Bulletin of Popular Information" were issued regularly, and numbers v and vi of the "Contributions from the Arnold Arboretum of Harvard University" were published during the year. Of the approximately 400 periodicals that come to the Library from all parts of the world 250 were received in exchange for these publications. Reprints from the "Journal" were exchanged for reprints from other publications.

The crowded condition of the stacks necessitated the addition of four new steel sections, of six shelves each, and the urgent need of the Library is still more room.—E. M. T.

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The above articles cover a total of about 1215 pages.—E. M. T.

Staff of the Arnold Arboretum, 1934–35

OAKES AMES, A.M., Arnold Professor of Botany, Supervisor.

JOHN GEORGE JACK, Assistant Professor of Dendrology.

ALFRED REHDER, A.M., Associate Professor of Dendrology and Curator of the Herbarium.

JOSEPH H. FAULL, Ph.D., Professor of Forest Pathology.

IRVING WIDMER BAILEY, S.D., Professor of Plant Anatomy.

KARL SAX, Ph.D., Associate Professor of Cytology.

EDGAR ANDERSON, S.D., Arborist.

IVAN MURRAY JOHNSTON, Ph.D., Research Associate.

CLARENCE E. KOBUSKI, Ph.D., Assistant Curator, Herbarium.

HUGH M. RAUP, Ph.D., Research Associate.

ETHELYN MARIA TUCKER, Librarian.

ERNEST J. PALMER, Collector and Research Assistant.

SUSAN DELANO MCKELVEY, Research Assistant.

CAROLINE K. ALLEN, Ph.D., Assistant in the Herbarium.

ETHEL ANTOINETTE ANDERSON, Business Secretary.

LOUIS VICTOR SCHMITT, Superintendent.

WILLIAM HENRY JUDD, Propagator.

ERRATA AND ADDENDA

Page 11, line 12 from below *add*—Handel-Mazzetti, Symb. Sin. VII. 673 (1933).

" " line 5 from below strike out **Synon. nov.**

" 24, line 17 *replace* comb. nov. *by* Handel-Mazzetti, Symb. Sin. VII. 682 (1933).

" 101, line 14 for *chinenese* read *chinense*.

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Synonyms are printed in *italics;* new names in **bold-face** type